Vet Med

VETERINARY MEDICINE LIBRARY

OHIO STATE UNIVERSITY NOV 8 1961 LIBRARY

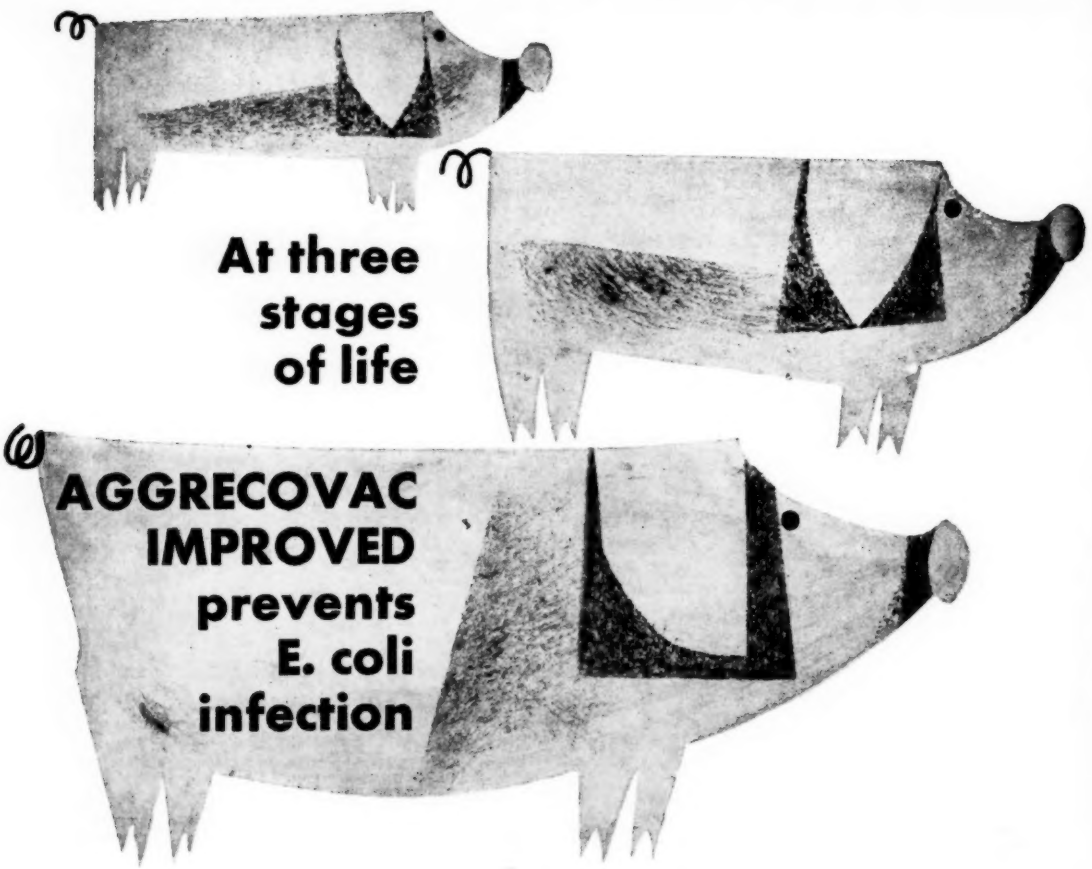
NOV 10 1961

#27 mag.

The Veterinary Record

PATRON: HER MAJESTY THE QUEEN

Vol. 73 No. 42 Issue No. 4352 1011-1052 Registered as a Newspaper



At three stages of life

AGGRECOVAC IMPROVED prevents E. coli infection

Because Aggrecovac Improved is composed of 6 strains of *E. coli*, it guards pigs during the three stages of life when they are likely to manifest *E. coli* infection. Vaccination of the dam prevents the piglet from getting scours in its first days. Subsequent vaccination of pigs prevents scours at weaning, and the oedema which kills so many of the best pigs.

For convenient immunisation against E. coli infections, stock up now with

AGGRECOVAC IMPROVED

Pfizer PFIZER LIMITED · SANDWICH · KENT

13142

THE VETERINARY RECORD

Founded by William Hunting, F.R.C.V.S., in 1888

Volume 73
No. 42

SATURDAY, OCTOBER 21st, 1961

7 Mansfield Street,
London, W.1.
Museum 6541

Congress Papers

SYMPOSIUM ON STAPHYLOCOCCAL MASTITIS*

1.—The Immunity of Staphylococcal Mastitis

BY

J. B. DERBYSHIRE

Agricultural Research Council, Field Station, Compton, Berkshire

SUMMARY.—The main lines of research in staphylococcal immunity are outlined and discussed in relation to vaccination against staphylococcal mastitis. Local vaccination of the udder requires further investigation before its value can be assessed, because of the possibility of non-specific responses. There is no evidence that the use of toxoid therapeutically is of value. Prophylactically, antitoxic immunity protects against certain strains of staphylococci. Progress has been made in the problem of immunisation against other strains, but the introduction of a vaccine which could confidently be used in the field should await a final solution to this problem.

Introduction

THERE is considerable current interest in staphylococcal immunity in both the veterinary and medical fields due to the increasing incidence of staphylococcal infections in animals and man, and the difficulties of treating such infections successfully. In veterinary medicine an efficient prophylactic vaccine for staphylococcal mastitis would be of considerable value in certain of our dairy herds. The problem of developing such a vaccine has engaged the attention of research workers for some time; this paper is an attempt to outline briefly the main lines of enquiry that have been followed and to summarise the present position with regard to knowledge in this field.

The staphylococcus is a complicated organism from the immunological viewpoint since in addition to possessing numerous bacterial antigens the coccus produces a variety of diffusible substances, the value of which as immunising agents should be considered. These include various toxins and the enzymic products such as coagulase, hyaluronidase and staphylokinase. Before discussing the literature dealing specifically with immunity in staphylococcal mastitis in ruminants it is necessary to outline briefly the results of experimental work in other species on the immunising power of these antigens.

Papers presented to the Annual Congress of the British Veterinary Association in Oxford on Monday, September 4th, 1961.

Immunising Power of Staphylococcal Antigens

Living vaccines. Living vaccines in rabbits have been shown to give partial immunity to a large dose of organisms, but to produce hypersensitivity to a small dose of bacteria (Panton & Valentine, 1929; Johanovsky, 1956). Brodie, Guthrie and Sommerville (1958) were able to protect rabbits by vaccination with a living, attenuated vaccine.

Killed cell vaccines. Only Forssman (1935, 1938) claimed to have protected rabbits with killed whole cell vaccines. There has been research recently on the immunising power of vaccines prepared from disrupted organisms. Greenberg and Cooper (1960) used the enzyme dornase to lyse staphyloccoci, and Stamp (1961) prepared soluble fractions from cells by ultrasonic disintegration or shaking. Both these papers describe the production of immunity in rabbits.

Toxoid. Most attention has been given to alpha toxoid. Experimental studies with this antigen in laboratory animals are too numerous to mention in detail. In general, animals vaccinated with alpha toxoid appear more resistant than controls when challenged. This is shown by an increased survival time, or the animals may survive challenge but with persistent local lesions. Clinical trials of toxoid and antitoxin in man indicate that antitoxic immunity in defence against staphylococci, if it is of value at all, is not of the same order as antitoxic immunity in the clostridial diseases or diphtheria. No information is available on the immunising power of staphylococcal leucocidin. The significance of this toxin in ruminants appears somewhat doubtful since Gladstone and van Heyningen (1957) stated that none of the 3 leucocidins which they described were active against sheep polymorphs.

Other diffusible products. There is limited experimental evidence from work in rabbits that coagulase may be of value as an immunising agent (Boake, 1956). However, there is no direct evidence that hyaluronidase, staphylokinase, lipase or proteases are of immunological significance in staphylococcal diseases, although they are known to be antigenic. It may be that these enzymes primarily serve the organism in a nutritional capacity, but certain of them may also help indirectly to preserve the bacteria from destruction when they have gained entrance into the tissues of the host.

Staphylococcal Antibodies in Cattle

Data on the occurrence of staphylococcal antitoxins in the blood and milk of dairy cattle are summarised in a recent comprehensive review by Brown (1960). This shows that antitoxins are found in the blood of a large percentage of dairy cattle. Titres increase with age and are higher in cows with staphylococcal-infected udders. The occurrence of staphylococcal antihyaluronidase in the serum of dairy cows was reported by Howell (1954), and Richou, Quinchon and Richou (1960) demonstrated the occurrence of inhibitors for the caseolytic, lecithinase, lipase and egg-yolk reactivity of staphylococci in a proportion of bovine sera. It is not clear whether cows with high natural titres of these antibodies are more resistant to staphylococcal mastitis than are those with low titres. Brown's paper also reviews the extensive literature dealing with the artificial stimulation of antitoxin production in cattle. Antitoxins can be readily produced in the serum by injections of formolised toxoid and higher levels are produced when killed staphylococcal cells, alum or aluminium hydroxide are combined with the toxoid.

Mention should be made here of the question whether circulating staphylococcal antibodies can pass through the mammary epithelium to exert their activity in the udder. This is clearly of fundamental importance if immunisation against mastitis is to be attempted by systemic vaccination. It appears from the literature that, except at the time of parturition and at the end of lactation, antibodies do not pass through the mammary epithelium of the normal cow even in vaccinated animals with high serum titres (Miller & Heishman, 1943; Edwards & Smith, 1959; Kerr, Pearson & Rankin, 1959). This has been confirmed (Derbyshire, 1960b) but it has also been shown that the mammary epithelium becomes fairly readily permeable to circulating antitoxin when it is subjected to quite mild irritation, such as occurs in mild mastitis. However, this means that even if systemic vaccination produced high levels of circulating protective antibody, mild mastitis could be expected to occur, and infection of the udder might not be prevented. This important conclusion is in general accord with the results of experiments in immunity which are discussed later, in which mild mastitis in vaccinated animals is recorded.

Local Immunity

Since the mammary epithelium forms at least a temporary barrier to the passage of antibody from the circulation there has been speculation that it might be possible to immunise the udder more effectively by injecting antigens through the teat canal rather than by the more conventional routes. Porterfield, Petersen and Campbell (1959) suggested that the bovine udder is a potent source of antibody production, but the findings of these authors were not confirmed by the work of Greenbaum and Miller (1960). Experiments have been described by Pillet, Giraud, Dutheil and Orta (1959a, b), however, in which a staphylococcal cell-toxoid injected through the teat canal protected the udder against the experimental inoculation of staphylococci 1 to 3 weeks later. Fourteen out of 15 control sheep developed acute mastitis whilst the vaccinates were unaffected, and intramuscular injection of the vaccine was less effective than infusion of the udder. A similar preparation was used to treat staphylococcal mastitis in cows by infusion of the udder by Plommet (1960), and recovery was reported in half the cows treated. Increasing doses of living staphylococci have been injected into the teat canal of goats (Derbyshire, 1961b); the infected gland of each goat became resistant to a massive intramammary dose of the organism, but the non-infected gland of the same goat was less resistant, suggesting local immunity.

It is not clear from any of this work whether the increased resistance which was demonstrated was associated with specific local immunity or whether there was a non-specific increase in resistance. Recent studies indicate that the resistance of the mammary gland to mastitis can be markedly enhanced by non-specific stimuli (Derbyshire, 1961c), making assessment of local immunity studies in the udder difficult unless these are carefully controlled. A further point is that the practicability of udder vaccination techniques for prophylaxis in lactating cows is doubtful on the evidence of Kerr *et al.*, which indicated that the infusion of staphylococcal toxoid through the teat canal of cows produced severe clinical reactions of the udder, characterised by tenseness, pain and altered secretion, even when the toxoid was diluted before infusion.

Field Studies in Cattle and Sheep

Reports on the use of staphylococcal immunising agents under field conditions are concerned with both therapy and prophylaxis. Rosati and Bertolino (1938) used a formalinised 18-hour broth culture of staphylococci therapeutically in sheep mastitis and claimed that this reduced mortality in the disease. Richou and Holstein (1941) stated that anatoxin had given good curative results in staphylococcal mastitis in cows, but it may be significant that a later paper recommended that vaccine therapy should be supplemented by antibiotics (Richou & Thieulin, 1955). Success in the use of staphylococcal toxoid therapeutically in cows in Great Britain was reported by Gould (1942) and Wilson (1942) but this work was completely uncontrolled. A further advocate of the use of toxoid for treatment in cows was Collinson (1949). Field reports of this nature should be viewed with extreme caution, however, particularly in view of the experimental findings of McLay, Rankin,

Loosmore and Slavin (1946). These workers showed that toxoid was totally ineffective in the treatment of experimentally produced staphylococcal mastitis in ewes, even though the treatment was given immediately clinical symptoms were observed. Reference to the therapeutic use of antitoxic sera in animals has not been found.

Several field trials are reported which have attempted to assess the prophylactic value of vaccination in cattle. A mixed autogenous vaccine containing staphylococcal toxoid and streptococcal anaculture was used in a dairy herd by Kearney and Maloney (1943). The authors claimed that infection was practically eradicated by the vaccine, but the trial was not adequately controlled. Ramon, Richou, Julienne, Jacquet and Gerbeaux (1951) recommended the immunisation of cows with toxoid, based on their demonstration that this product would stimulate antitoxin production. In a recent paper Slanetz, Bartley and Allen (1959) published the results of a trial in cattle conducted over a period of 5 years. The authors claimed that vaccination with toxoid or bacterin-toxoid prevented the spread of infection within the herds, and reduced the number of acute mastitic outbreaks. Vaccination did not influence recovery of quarters with well-established infections at the commencement of the trial. Another recent field trial of vaccination was by Pearson (1959) who used an autogenous cell-toxoid vaccine. Observations were made for 2½ years, and during the first 18 months of this period there was a significant difference in the number of heavy infections and clinical cases in the 25 vaccinated cows when compared with the 18 controls. In the last 12 months, however, there were 8 clinical cases in the vaccinated group compared with 5 in the controls. This was interpreted as indicating that the reinforcing doses of vaccine given every 6 months were insufficient to maintain immunity.

Experimental Studies in Cattle and Sheep

The earlier experimental studies on the prophylactic use of vaccination against staphylococcal mastitis dealt with the disease in sheep, the most comprehensive being those of Minett (1939), using toxoid and alum-precipitated toxoid. Minett found that these products prevented the systemic effects, and to some extent the local effects resulting from the inoculation of a mixture of staphylococcal culture and toxin into the teat canal. However, all except 1 of the sheep in these experiments were non-lactating, and it cannot be assumed that lactating animals would respond in the same way. More recently, Spencer, Stewart and Lasmanis (1956) reported that 6 sheep vaccinated with a dried formolised culture of *M. pyogenes* suspended in 10 per cent. aqueous aluminium hydroxide were not protected against challenge by intramammary inoculation, but the significance of this result is doubtful because the vaccine did not produce high antitoxin levels in the sheep.

Little has been published on the testing of staphylococcal vaccines in cattle under experimental conditions. In a preliminary report on immunisation, Spencer *et al.* showed that the reaction in 16 quarters of cows vaccinated with a dried formalinised staphylococcal culture suspended in 10 per cent. aqueous aluminium hydroxide was less severe than the reaction in 5 quarters of non-vaccinated cows when all were challenged by the inoculation through the teat canal of a culture of the homologous strain of *Staph. aureus*. Three cows were vaccinated with a suspension of the dried culture in mineral oil, but this produced a severe local reaction and the cows were not subjected to challenge. Slanetz *et al.* reported that 4 cows vaccinated with bacterin-toxoid showed a milder reaction than did 4 non-vaccinated cows when challenged *via* the teat canal with 1 to 5 billion virulent mastitis staphylococci; but when the challenge dose was increased to 20 billion organisms the reaction of vaccinated and control cows was indistinguishable. Neither of these papers indicated whether the immunity produced was antibacterial or antitoxic in nature since the vaccines used contained killed bacterial cells in addition to toxoid.

Experimental Studies in Goats

An attempt is being made at Compton to overcome the economic difficulties of using large numbers of cows for experimental studies in mastitis by conducting preliminary tests of staphylococcal vaccines in goats, following the successful use of this species for research on streptococcal mastitis by Pattison and his colleagues. Initial studies (Derbyshire, 1960a) demonstrated that an adjuvant cell-toxoid prepared from *Staph. aureus* strain 201 conferred a high level of protection against challenge by the intramammary inoculation of 10^9 living organisms of the homologous strain. The reaction of the goats to challenge was characterised by measurement of the milk yield and the bacterial and neutrophil content of milk samples, in addition to clinical and histopathological examination of the udders, and these methods were used in later experiments. The immunity produced by the adjuvant cell-toxoid was shown to be dependent on its content of toxoid. Goats with high levels of circulating antitoxin showed only a mild, transient reaction to challenge, whilst gangrenous or severe purulent mastitis developed in the control animals. Protection by this vaccine against strain 201 mastitis was confirmed in cows in a small-scale experiment.

In subsequent cross-protection experiments in goats (Derbyshire, 1961a) strain 201 adjuvant cell-toxoid was tested for immunising power against a variety of strains of staphylococci isolated from natural field cases of mastitis. The vaccine conferred a high level of immunity against challenge by strain 106, in addition to strain 201, but little protection against strains BB, N90 and S20T was produced. These strains never produced gangrene in vaccinated goats, but severe, purulent mastitis did occur. Vaccination of goats with adjuvant cell-toxoid prepared from strain BB gave no greater protection against strain BB than did the 201 vaccine. It is clear that staphylococci of the BB type are able to produce mastitis in animals which have high

levels of circulating antitoxin. A further experiment failed to show significant differences in the development of circulating antibodies when severe mastitis was produced in goats by strain 201 or strain BB, although the vaccination experiments had shown a marked immunological difference between the strains.

An attempt was next made to confer immunity to experimental strain BB mastitis in goats by producing subcutaneous abscesses with living strain BB staphylococci prior to challenge of the udder (Derbyshire, 1961b). In this experiment, 3 out of 4 goats with abscesses showed evidence of immunity by developing only a mild transient reaction following intramammary challenge. This indication that under certain circumstances immunity to this type of strain can be produced has encouraged further attempts to produce immunity to strain BB by means of a non-living vaccine. Immunological studies using a mixture of alpha haemolysin toxoid, coagulase and leucocidin (Derbyshire & Helliwell, 1961) have given some hope of success. Out of 6 goats vaccinated with alpha lysin-coagulase-leucocidin and challenged by the intramammary inoculation of 10^9 strain BB staphylococci only 2 developed severe purulent mastitis, whilst of 4 untreated goats gangrenous mastitis occurred in 2 and severe mastitis in the remainder. The remaining 4 vaccinated goats showed only a mild reaction to challenge, but the reasons for the irregular response to vaccination were not apparent from the serological observations that were made. This line of investigation using concentrated preparations of staphylococcal antigens is being continued and developed.

Discussion

The general literature on immunity to staphylococci dealing with experiments in small laboratory animals, although considerable in volume is of limited value in the mastitis field. It cannot be safely assumed that the results of experiments in rabbits can be applied directly to cows. For this reason the interesting findings that attenuated staphylococci and disrupted staphylococcal cells confer immunity in rabbits require confirmation in large animals. However, these techniques open up interesting possibilities in the veterinary field which are worthy of investigation. Another subject worthy of further investigation is that of local immunity in the udder. Because of the considerable degree of non-specific resistance of the udder very careful experiments which will distinguish between specific local immunity and an increase in non-specific resistance are called for. It is also possible that a technique might be found for increasing local non-specific resistance in the udder which might have practical possibilities.

There is no incontrovertible evidence that staphylococcal toxoid is of value in the treatment of mastitis. From the point of view of prophylaxis, however, antitoxic immunity appears to confer a high level of protection against certain strains of staphylococci. Against other strains antitoxic immunity does not prevent the severe manifestations of the disease; for this type of strain other antigens such as coagulase and leucocidin are probably also of importance. Further investigation of methods of immunising against staphylococci of this type are indicated. This may involve testing further diffusible products for immunising power, and should perhaps include attention to the cellular antigens of the staphylococcus. Detailed work of this sort is difficult to conduct under field conditions, and large-scale experimental studies in cows are expensive. The use of goats holds promise that some of these problems in staphylococcal immunity may be clarified by carefully controlled experiments. Because of the economic importance of staphylococcal mastitis and the difficulties of therapy and control, the disease would appear to offer considerable justification for further immunological research. It will be seen that several problems require solution before a staphylococcal vaccine can be confidently used in the field against mastitis, but the future is not without hope.

References

BOAKE, W. C. (1956). *J. immunol.* **76.** 89.

BRODIE, J., GUTHRIE, W., & SOMMERVILLE, T. (1958). *Brit. J. exp. Path.* **39.** 199.

BROWN, R. W. (1960). *Amer. J. vet. Res.* **21.** 1,006.

COLLINSON, R. W. (1949). *J. Amer. vet. med Ass.* **114.** 147.

DERBYSHIRE, J. B. (1960a). *J. comp Path.* **70.** 222.

———. (1960b). *Res. vet. Sci.* **1.** 350.

———. (1961a). *J. comp. Path.* **71.** 146.

———. (1961b). *Res. vet. Sci.* **2.** 112.

———. (1961c). Unpublished.

———, & HELLIWELL, B. I. (1961). In preparation.

EDWARDS, S. J., & SMITH, G. S. (1959). *J. comp. Path.* **69.** 208.

FORSSMAN, J. (1935). *Acta. path. microbiol. Scand.* **12.** 536.

———. (1938). *Ibid.* **15.** 396.

GLADSTONE, G. P., & VAN HEYNINGEN, W. E. (1957). *Brit. J. exp. Path.* **38.** 123.

GOULD, G. N. (1942). *Vet. Rec.* **54.** 106.

GREENBAUM, D. S., & MILLER, L. (1960). *J. Lab. Clin. Med.* **55.** 229.

GREENBERG, L., & COOPER, MARGARET Y. (1960). *Canad. Med. Ass. J.* **83.** 143.

HOWELL, D. G. (1954). *J. Path. Bact.* **68.** 287.

JOHANOVSKY, J. (1956). *Cas. lek. ces.* **95.** 445.

KEARNEY, W., & MALONEY, P. D. (1943). *Vet. Rec.* **55.** 489.

KERR, W. R., PEARSON, J. K. L., & RANKIN, J. E. F. (1959). *Brit. Vet. J.* **115.** 105.

MCLAY, M. H., RANKIN, J. D., LOOSMORE, R. M., & SLAVIN, G. (1946). *J. comp. Path.* **56.** 139.

MILLER, W. T., & HEISHMAN, J. O. (1943). *Amer. J. vet. Res.* **4.** 318.

MINETT, F. C. (1939). *J. comp. Path.* **52.** 167.

PANTON, P. N., & VALENTINE, F. C. O. (1929). *Brit. J. exp. Path.* **10.** 257.

PEARSON, J. K. L. (1959). *J. dairy Res.* **26.** 9.

PILLET, J., GIRAUD, O., DUTHEIL, H., & ORTA, B. (1959a). *Ann. Inst. Past.* **96.** 365.

———, ———, ———, & ———. (1959b). *Ibid.* 591.

PLOMMET, M. (1960). *Ann. Inst. Past.* **99.** 618.

PORTERFIELD, I. D., PETERSEN, W. E., & CAMPBELL, B. (1959). *Vet. Med.* **54.** 1.

RAMON, G., RICHOU, R., JULIENNE, P., JACQUET, J., & GERBEAUX, C. (1951). *Rev. immunol.* **15.** 321.

RICHOU, R., & HOLSTEIN, G. (1941). *Bull. acad. Vet.* **14.** 100.

———, & THIEULIN, G. (1955). *Rec. med. Vet.* **131.** 73.

ROSATI, T., & BERTOLINO, P. (1938). *Clin. Vet.* **61.** 465.

SLANETZ, L. W., BARTLEY, C. H., & ALLEN, F. E. (1959). *J. Amer. vet. med. Ass.* **134.** 155.

SPENCER, G. R., STEWART, J. H., & LASMANIS, JANIS. (1956). *Amer. J. vet. Res.* **17.** 594.

STAMP, LORD. (1961). *Brit. J. exp. Path.* **42.** 30.

WILSON, H. M. (1942). *Vet. Rec.* **54.** 137.

2.—The Epidemiology of Staphylococcal Mastitis

BY

IAN DAVIDSON

Central Veterinary Laboratory,
New Haw, Weybridge

THE object of this epidemiological contribution to the symposium on staphylococcal mastitis is to suggest how staphylococci live, multiply and spread in dairy herds and what are the vulnerable points at which they may most profitably be attacked in order to reduce the incidence of staphylococcal mastitis. First, the ecology of mastitis-producing staphylococci will be described. This will be followed by a discussion of methods of controlling staphylococcal mastitis, and the paper will be concluded with an assessment of the possibility of eradication.

The Ecology of Mastitis Staphylococci

Staphylococci are parasites of animals and it is the coagulase positive group, known as *Staphylococcus aureus* or *Staphylococcus pyogenes*, which is most often associated with disease including mastitis. Occasionally mastitis is associated with coagulase negative staphylococci but such cases are relatively infrequent and almost always mild; little is known about the ecology of these organisms and this paper is concerned exclusively with the coagulase positive staphylococci.

Observations on the ecology of staphylococci in a herd of dairy cattle over a period of 6 years were reported by the present author (Davidson, 1961). In a detailed study of this kind it is possible to use a limited number of animals only and the work reported was carried out in a herd of about 24 milking cows. Consequently, one must bear in mind that all strains of staphylococci probably do not behave in the same way in all herds at all times. Nevertheless, the study was continued over a period of years during which a variety of strains of staphylococci, fairly representative of the staphylococcal flora of the cattle population of the whole country, passed through the herd. Moreover, the herd consisted of a mixture of different dairy breeds and types drawn from a wide variety of farms and districts. It is reasonable to suppose, therefore, that the results were representative of the situation in most herds.

Staphylococci isolated from milk, the udder surface, the external orifices and various areas of skin of the cows as well as from the hands of the cows' human contacts, were examined with a set of bacteriophages specially selected for typing bovine staphylococci (Davidson, in the press). By this means a number of different strains were identified and their progress followed.

Although 70 different strains were recognised, a little more than 90 per cent. of the isolations made were accounted for by the 13 strains which were associated with mastitis. These latter were present in the herd for periods ranging from 3 months to 3½ years, while the non-mastitis strains comprised 30 which persisted for shorter periods, 3 which were introduced experimentally and 24 which were isolated solely or chiefly from human contacts. From this it may be concluded that any staphylococcus which is able to maintain itself for more than a short time in a herd of cows is likely, sooner or later, to cause mastitis.

An account of the history of 3 of the mastitis strains will illustrate the conclusions reached.

One of these strains was introduced by a purchased cow which, before being brought into the herd, excreted staphylococci in the milk. The cow was allowed to enter the herd after this intramammary infection had been successfully treated and staphylococci were never again recovered from her milk. However, this staphylococcus persisted on her teat skin and from this site it spread to other cows, soon becoming the commonest strain in the herd. It produced its first mastitis case just over a year after its introduction.

Another strain was found repeatedly in large numbers on the hands of one of the milkers and its phage sensitivity suggested that it was a human rather than a bovine strain; 3 weeks after its first appearance it was recovered from the body surface of the cows but did not cause disease until almost 2 years later when it was recovered from a mastitis case. Four other mastitis cases and 5 cases of pustular dermatitis of the udder (see below) followed. All these were treated successfully and the staphylococcus disappeared when the human carrier left.

A third strain was also introduced by one of the milkers, but, in this case, the man concerned carried only small numbers of organisms for only 2 weeks and their phage sensitivity was typical of bovine staphylococci. A series of cases of pustular dermatitis of the udder followed, but this strain did not cause mastitis until it had been present in the herd for 7 months. It eventually became the commonest strain and caused more mastitis cases than any other.

The history of these strains illustrates some of the ways in which staphylococci can be introduced into a herd and clearly indicates that these organisms are not obligatory intramammary parasites; 6 of the 10 mastitis strains which made their first appearance during the course of the work maintained themselves in the herd for some weeks or months before an intramammary infection occurred. Each was found most often on the udder surface during this time and, in most cases, multiplication occurred there before recoveries were made from other sites.

Although staphylococci were found at one time or another in all the sites sampled, the udder was the site where they multiplied most often. As well as being found in milk, staphylococci were frequently

recovered in large numbers from the skin of the udder and teats, often of cows which were not themselves shedding staphylococci in the milk. In some cases, the staphylococci were associated with lesions on the udder skin (though never on the teats). These lesions consisted of pustules, 2 to 5 mm. in diameter, usually surrounded by erythema and sometimes by oedema. They developed rapidly, usually rupturing within 24 hours, were superficial and appeared to cause the cow little discomfort. In many cases, however, staphylococci multiplied on the udder skin without producing visible lesions.

Staphylococci were found on other areas of skin less commonly and, in general, in much smaller numbers. However, on a number of occasions large numbers were found on the perineal skin associated with the same kind of pustular dermatitis as that seen on the udder. Infections of this site were much less frequent than those of the udder and, on the whole, of shorter duration. In some cases, the pustular dermatitis extended to the under-surface of the tail where it is in apposition to the perineum.

Of all the sites sampled, the external orifices yielded staphylococci least frequently, although some evidence of independent multiplication in the vagina was obtained.

To obtain more information about the relationship between these various sites as sources of staphylococci, a statistical analysis was made of the incidence of each mastitis strain in each site over a 3-year period. This suggested that isolations from other areas of skin, and from orifices, depended largely on the presence of staphylococci in sufficient numbers on the udder and teat skin (see Table I). Of the 9 mastitis strains present during this period, only the 2 with the highest incidences on the udder surface were recovered from all the other sites. Those strains with low incidences on the udder surface were recovered from the least number of the other sites.

This conclusion was supported by the observations on seasonal incidence. It was noted that the number of staphylococci recovered from the udder surface rose rapidly in September or October each year, remained high in the autumn and winter and fell gradually in the spring. There was a similar seasonal rise in the numbers recovered from other areas of skin but this occurred later than the rise on the udder.

Another important observation was that none of the 28 heifers which entered the herd during the 3 years when extensive samples were taken introduced a new strain of staphylococcus even though these animals came from many different farms in various parts of England and Scotland.

These observations are supported by those of Spencer and Lasmanis (1952), who found a much higher incidence of pathogenic staphylococci on the teat skin of 62 cows than on their flanks or vulvae; of Rountree, Freeman and Johnston (1956), who failed to find pathogenic staphylococci in the noses of 2 herds of cows, one of which was extensively affected with staphylococcal mastitis; of McDiarmid

TABLE I

SAMPLES POSITIVE FOR EACH STRAIN OF STAPHYLOCOCCUS: 1956–59
(Only those samples taken in the same week from all sites of the same cow are included)

Strain number		Teats	Udder	Sacral region	Belly	Chest	Poll	Caudal Folds	Vagina	Lips	Rectum	Nose	Eyes
1	N	5	2										
	%	1·81	1·77										
2	N	40	16	1	2	3		2	4		2		
	%	2·52	2·06	0·23	0·52	0·69		0·47	0·94		0·52		
8	N	93	45	6	8	3	4	4	5	10			
	%	5·33	5·26	1·27	1·90	0·64	0·86	0·86	1·08	2·12			
10	N	12	4		2								
	%	1·40	1·02		1·12								
29	N	399	243	77	31	40	24	21	26	13	6	20	8
	%	12·16	14·77	8·78	3·74	4·56	2·76	2·42	2·99	1·48	0·72	2·28	0·93
43	N	31	12	1	3	3	1						
	%	2·16	1·61	0·26	0·78	0·78	0·26						
39	N	563	279	180	143	126	63	57	47	25	30	18	5
	%	21·33	20·45	24·32	20·31	17·90	8·95	8·10	6·68	3·55	4·34	2·56	0·71
66	N	38	17	3	2	2	2	1	4	1	2		
	%	2·51	2·19	0·75	0·50	0·50	0·50	0·25	1·00	0·25	0·50		
82	N	6	4	2	1			1					
	%	0·91	1·16	1·11	0·56			0·56					
All strains	%	36·19	37·81	30·79	23·19	20·18	10·82	9·90	9·90	5·59	4·80	4·33	1·51

Taken from Davidson, I. (1961) *Res. vet. Sci.* **2**. 22.

N = Number of positive samples.
% = Percentage positive for each strain of samples taken while that strain was present in the herd.

(1947) and Edwards and Rippon (1957), who found pathogenic staphylococci on the teats of cows which were not excreting them in the milk; and of Jones (1918), Little and Foley (1935) and Pauluzzi (1953), who isolated pathogenic staphylococci from skin lesions on cows' udders.

Another important observation is that of Neave and Dodd (in the press) on the connexion between intramammary infections occurring during the dry period and the number of staphylococci on the teat skin. They used 28 animals at the end of their first lactation and, after the last milking of the lactation, 3 teats of each udder were immersed in a culture of staphylococcus. For the right fore teats undiluted culture was used, for the right hind a 1 : 500 dilution and for the left hind a 1 : 25,000 dilution. During the ensuing dry period, 10 intramammary infections resulted in the quarters exposed to the highest concentration of organisms, 2 in those exposed to the 1 : 500 dilution and only 1 in the control quarters. This illustrates clearly that the number of staphylococci on the teat surface is an important factor in determining whether intramammary infection occurs during the dry period.

Human beings do not appear to be important sources of infection for cattle although a few cases have been reported. The one quoted above (Davidson, 1961) appeared to be unusual since only one of the 25 strains associated primarily with the cows' human contacts established itself in the herd. Steede and Smith (1954) investigating an outbreak of staphylococcal food-poisoning associated with cows' milk, found that the cow from which the milk had been obtained was infected with a staphylococcus apparently derived from the cowman, who was a nasal carrier. Wallace, Quisenberry and de Harne (1960) found 4 cows infected with staphylococci whose phage sensitivity suggested that they were of human origin; 3 of these were in a herd in which one of the cowmen carried the same staphylococcus in his nose and in a staphylococcal furuncle on his back. Phage-typing studies (Williams and Jevons, 1961; Davidson, in the press) suggest that most of the commonest bovine strains differ from most of the commonest human strains. One may conclude that there is some overlapping between the staphylococcal population of cattle and human beings and that cattle may sometimes become infected with a human staphylococcus when sufficiently heavily exposed, but that this does not happen often.

The following conclusions are relevant to the control of staphylococcal mastitis.

1. Any pathogenic staphylococcus which establishes itself in a dairy herd is a potential cause of mastitis.
2. The main reservoir of mastitis staphylococci is in adult cattle.
3. Mastitis staphylococci are not obligatory intramammary parasites but can maintain themselves in a number of sites.
4. The most important of these sites are the milk-secreting tissue of the udder and the skin of the udder and teats.
5. Although multiplication occurs in sites remote from the udder, the evidence suggests that most infections of such sites are secondary to infections of the udder.

Controlling Staphylococcal Mastitis

All the available ecological evidence points to the udder as the most important source of mastitis staphylococci. This suggests that udder to udder transmission is the chief way in which infection is disseminated, that transfer of infection is most likely to occur at milking time, and that hygienic measures applied during milking may be the most effective way of controlling staphylococcal infection. In this section of the paper, evidence will be presented which largely substantiates these propositions.

Transmission at milking time occurs through 3 agencies, *viz.* the milking machine, the milkers' hands and the udder cloths. Some success has been achieved in controlling staphylococcal mastitis by taking suitable precautions with these 3 agencies, together with the segregation and treatment of infected cows.

Methods of disinfecting milking machines have been discussed recently by Wilson and Davidson (1961). These authors recommended that, after each cow was milked, the milk tubes and teat cups should be flushed out with running cold water or, better still, water at 90°C. should be circulated through the milking unit for 6 seconds. They pointed out the limitations of the more usual method of dipping the teat cups in disinfectant.

With regard to the milkers' hands, reliance must be placed on educating the milker to handle the udder as little as possible and to avoid contaminating his hands with milk or anything coming into contact with the udder.

Since multiplication on the udder and teats occurs so commonly, no method of controlling staphylococcal mastitis would be soundly based unless it were able to reduce the amount of infection disseminated from this site. Furthermore, intramammary treatment, even if it produces a bacteriological cure, may have no more than a transient effect if the cow is able to re-infect itself from its own teat skin.

Newbould and Barnum (1956) found that a farm using a chlorine compound for udder washing and teat cup dipping had much larger numbers of staphylococci on the teat cup liners than 2 farms which used chlorhexidine. The farm using chlorhexidine at 400 p.p.m. had an average count several times lower than that using the same substance at 250 p.p.m. Since there was little difference between the 3 herds in the number of staphlyococci being shed in the milk, these authors concluded that the chief source of contamination of the liners was the teat skin and that chlorhexidine was effective in reducing the numbers found there. To test these hypotheses they changed the disinfectant used for udder washing to chlorhexidine on the first farm and to the chlorine compound on one of the others, while leaving the teat-cup dipping procedure unchanged. This was followed by a substantial and rapid fall in the number of staphylococci on the liners of the first farm and a rise in that on the liners of the second.

Confirmation of the efficacy of chlorhexidine as an udder wash was obtained by the present author in experiments with monozygous twins (Reports, 1958 & 1959). The object of these experiments was to determine whether sufficiently rigorous hygienic precautions at milking time would effectively control the transmission of staphylococci. In an experiment on the control of staphylococci on the udder skin, 1:5,000 chlorhexidine was used as an udder wash in one group of cows, using a separate udder cloth for each cow, and the milking unit was flushed with running water after each cow was milked. In the control group, the udders were washed with water, again using a separate cloth for each cow, and the milking unit was transferred directly without rinsing. This combination of precautions reduced the number of staphylococci found on the udder surface in the experimental group to less than 1/8th that in the control group.

In a further experiment, the cows were exposed to donor animals shedding a particular strain of staphylococcus in the milk. The donors were milked first and the same precautions were taken in the experimental group. The introduced staphylococcus caused mastitis in 5 of the 9 control cows but in none of those in the experimental group. As in the first experiment, there was a marked reduction in the number of staphylococci on the udder surface in the experimental group.

Thus, in these experiments, a combination of antibacterial udder wash, individual udder cloths and rinsing the milking unit with running cold water after milking each cow was effective in controlling the spread of infection and reducing the amount of mastitis.

In an uncontrolled trial, Schalm and Lasmanis (1957) were also able to reduce the incidence of intramammary infections in a herd of cows by a combination of treatment and hygienic precautions. They milked the infected cows last, washed the udder with a chlorine disinfectant and dipped the teats in the same disinfectant after milking. However, although this regimen was maintained for 12 years, staphylococci were not eliminated altogether.

Oliver, Dodd and Neave (1956) found that dipping the teats in 5 per cent. tincture of iodine after the last milking of the lactation significantly reduced the number of new intramammary infections occurring during the dry period.

It is suggested that the following measures are essential to the control of staphylococcal mastitis.

1. Add to the udder washing water an antibacterial agent capable of suppressing the growth of staphylococci on the udder skin. The best results will be obtained if daily udder washing is continued through the dry period as well as during lactation.

2. Use a separate udder cloth or paper towel for each cow.

3. Remove as much infection as possible from the teat cups and milk tubes after milking each cow, *e.g.*, flush out with running water.

4. Treat clinical cases of mastitis promptly and, as far as possible, milk infected cows last.

Is Eradication Possible?

Eradication of the causal agent is the ideal to be aimed at in the control of any infectious disease and no discussion of the epidemiology of staphylococcal mastitis would be complete without an assessment of whether eradication is possible.

The preceding sections of the paper have shown that the udder itself is the most important source of infection and that the rate of transmission of infection from cow to cow can be materially reduced by taking rigorous hygienic precautions at milking time. It is possible that staphylococci would be unable to maintain themselves in a herd indefinitely in the absence of infection of the udder. If the cycle of udder to udder transmission were broken, treatment of intramammary and udder skin infections would have the best chance of success and, provided that these treatments were completely effective, it is possible that eradication might be achieved.

The author attempted this in his experimental herd (Report, 1959) using the control methods recommended above. Fortunately, all the staphylococci present in the herd at that time were sensitive to penicillin and this antibiotic was used to treat intramammary infections. The combination of control measures and treatment was followed by a gradual drop in the number of staphylococci recovered from all sites sampled, although small numbers persisted in some of the skin sites for up to a year. After one year, the only infected sites remaining were the perineum of one of the 2 bulls and the intramammary tissue of one cow, which still excreted staphylococci intermittently despite prolonged treatment.

It is evident, therefore, that eradication of staphylococci from a herd is likely to take many months and, with the methods and materials at present available, cannot be achieved with certainty. Furthermore, the risk of reintroducing infection by purchased cattle or by human beings who are temporary carriers of bovine staphylococci is probably fairly high. However, the methods needed for the control of staphylococcal mastitis lead to a gradual fall in the staphylococcal population of a herd; when this has occurred, intramammary treatment has the best chance of success and may, under favourable conditions, lead to eradication.

References

DAVIDSON, I. (1961). *Res. vet. Sci.* **2**, 22.

EDWARDS, S. J., & RIPPON, J. E. (1957). *J. comp. Path.* **67**, 111.

JONES, F. S. (1918). *J. exp. Med.* **28**, 721.

LITTLE, R. B. & FOLEY, E. J. (1935). *J. Amer. vet. med. Assoc.* **87**, 637.

MCDIARMID, A. (1947). *Vet. Rec.* **59**, 11.

NEWBOULD, F. H. S., & BARNUM, D. A. (1956). *Canad. J. comp. Med.* **20**, 139.

OLIVER, J., DODD, F. H., & NEAVE, F. K. (1956). *J. Dairy Res.* **23**, 212.

PAULUZZI, L. (1953). *Atti Soc. ital. Sci. vet.* **7**, 993.

Report on the Animal Health Services in Great Britain (1958). p. 45.

Report on the Animal Health Services in Great Britain (1959). p. 42.

ROUNTREE, P. M., FREEMAN, B. M., & JOHNSTON, K. G. (1956). *J. Path. Bact.* **72**, 319.

(*Concluded at foot of col. 1 overleaf*)

3.—The Treatment of Staphylococcal Mastitis

BY

C. D. WILSON

Central Veterinary Laboratory, Weybridge

SUMMARY.—The treatment of staphylococcal mastitis is described by reference to the clinical disease affecting the individual cow and to the subclinical form where there is usually a herd problem.

The incidence of both forms is assessed and it is shown that the loss of milk from subclinical staphylococcal mastitis is nearly three times that from the clinical form.

In treating the clinical case, the various methods employed are discussed with particular reference to the antibiotics and the different ways in which they are used. It is considered that subclinical mastitis is best dealt with as a herd problem by preventing infection gaining access to the udder rather than attempting to cure it once it has become established.

1. Clinical Mastitis

IN large-animal practice the amount of money available to treat a disease is determined by the size of the economic loss to the owner of the animals. It would obviously be unwise to employ a treatment whose cost equalled or exceeded the economic loss likely to be sustained.

Thus it is imperative that we should have a reasonably accurate assessment of the cost of any disease it is hoped to treat; more particularly is this true of a disease which is widespread throughout the country.

In the case of staphylococcal mastitis we are faced with some difficulties because we do not have an accurate assessment of the incidence of clinical mastitis associated with *Staph. pyogenes* infection. We can, however, make a guess which has been inspired by figures which are either published or in press.

Recently 3 surveys have been carried out to try to determine the incidence of clinical mastitis in the country. The lowest figure was that given in the Report on Disease Wastage (1957-8) when it was stated that the annual incidence of clinical mastitis in the national herd was 10.5 per cent. This was made up of acute mastitis (3.3 per cent.), subacute mastitis (6.7 per cent.) and summer mastitis (0.5 per cent.). These figures were obtained from 4 monthly visits to herds of various sizes, and appeared to rely too much (a) on the diagnostic ability of a layman and (b) on the memory of the owner and his cowman which for a variety of reasons might not be too reliable.

Another survey was carried out by the Milk Marketing Board (1956-7) in association with the National Institute for Research in Dairying. In this survey on one day a month cowmen in selected herds were asked how many cows had mastitis in the past 24 hours using as the lowest criterion of affection the presence of clots in the milk. It was found that on any one day 1 per cent. of the cows in the national herd would be found to have some form of clinical mastitis. Many of these cows would be producing altered milk for a number of days and so the figures are not so high as they appear; but even though the figures are not directly comparable to the national disease survey figures it does suggest that the estimate of the latter of the incidence of clinical mastitis was conservative in the extreme.

Objections can be made to the M.M.B. survey for very much the same reasons as those for which the other survey was criticised. It also relied upon the diagnoses of laymen, and while the individual cowman's memory was not overtaxed to recall the mastitis cases occurring in the previous 24 hours, he might still be reluctant to admit that mastitis was a problem in his herd.

Both these surveys were on a national scale and included samples of herds which were selected on a random basis to give a statistically acceptable sample. A third survey which was carried out at Reading on all the machine milked herds within a 10-mile radius of Reading (Howell *et al.*, 1961) could be criticised on the grounds that it was confined to one small area of the country and that only machine milked herds were used. The first objection is a valid one and it would be unwise to accept the figures found in one locality for a disease of such infinite variety as mastitis and apply them nationally. The fact that only machine milked herds were used is of little import because nearly 100 per cent. of herds over 15 cows are now machine milked.

The Reading survey had one great advantage: a veterinary surgeon examined each cow clinically, examined milk samples from each cow for the presence of abnormalities and also carried out a bacteriological examination. It was found in this survey of 140 herds involving 5,000 cows that at any one milking 5 per cent. of the cows were giving milk which was so altered as to be apparent to the careful inspection of a fore-milk cup by the cowman. This figure appears to be a realistic one and in keeping with the figure of 25 per cent. which was obtained

---

The Epidemiology of Staphylococcal Mastitis,—*Concluded.*

SCHALM, O. W., & LASMANIS, J. (1957). *Amer. J. vet. Res.* **18,** 778.

SPENCER, G. R., & LASMANIS, J. (1952). *Amer. J. vet. Res.* **13,** 500.

STEEDE, F. D. F., & SMITH, H. W. (1954). *Brit. med. J.* **2,** 576.

WALLACE, G. D., QUISENBERRY, W. B., & DE HARNE, M. A. (1960). *U.S. Publ. Hlth. Rep.* **75,** 457.

WILLIAMS, R. E. O., & JEVONS, M. P. (1961). *Zent. F. Bact. I. Orig.* **181.** 349.

WILSON, C. D., & DAVIDSON, I. (1961). *Vet. Rec.* **73,** 321.

from the same survey for the incidence of subclinical mastitis as revealed by the Whiteside test.

From the figures published in the Report of the Animal Health Service each year, the steady increase of staphylococci as the main organism responsible for clinical mastitis has been apparent, so that now staphylococci alone or in association with other mastitis organisms are responsible for 30 per cent. of the cases of clinical mastitis and the majority of these cases are acute.

Even if we accept the low figures of the national survey of 10 per cent. for the incidence of *clinical* mastitis then 3 per cent. of all the cows in the national herd will have clinical mastitis associated with this infection and many of these cases will be acute.

O'Donovan, Dodd and Neave (1960) have shown that a cow with subclinical mastitis (mainly staphylococcal) will lose on the average 10 per cent. of its anticipated yield in an infected lactation, and it would not be unreasonable to assume that a cow with *clinical* staphylococcal mastitis will lose at least twice that amount. Thus the cost in milk alone as the result of the clinical disease will be 20 per cent. of 3 per cent. of the national milk sales, *i.e.* 0.6 per cent. of £270 million = £1.6 million.

This is the cost of the clinical disease in loss of milk alone. While the money spent in treating one individual cow will depend upon its age, pedigree, milk yield, stage of lactation, etc., the fact that such a gross loss is suffered each year by the farming community makes it very clear that this disease justifies a great deal of money being spent on it purely to find out the best methods of curing the clinical disease once it has become established in a cow. The present method of ringing the changes on an ever increasing variety of antibiotics administered by different routes seems to lack reasoned approach and it is time that we paused and studied the position and considered what would be a rational method of treatment of clinical mastitis.

It is impossible to tell what the causative organism is, in a case of mastitis, purely from examination of the cow and the milk. One can make intelligent guesses, but Berger and Francis (1951) in their survey of clinical cases have shown how difficult it is to be accurate as to the causal organism on purely clinical grounds. Thus when a case of mastitis is met, and there are no previous cases in the same herd to act as a guide, it is imperative that the treatment given shall have the widest possible cover and will include both the gram-positive and gram-negative ends of the bacterial spectrum. In selecting the antibiotics notice has also to be taken of the occurrence of resistance among the mastitis bacteria to the various antibiotics, and this is particularly true of the staphylococci.

Since 1949 periodical checks have been made on the resistance of staphylococci to the various antibiotics as they came into general use and the picture that this unfolds is not an encouraging one. At each examination the number of strains of staphylococci resistant to penicillin tends to increase, and it would appear from Table I that this in time will be true of the other antibiotics.

This picture of increased resistance to certain antibiotics is more likely to be associated with greater usage of these antibiotics rather than any inherent properties preventing the development of resistance in the other antibiotics. Unless some new wonder drug emerges it would seem that we shall be doomed to try out, use, and then discard one antibiotic after another until cows will be infected with some of the most resistant staphylococci known to man.

TABLE I

RESISTANCE OF *Staphylococcus pyogenes* TO ANTIBIOTICS

Antibiotic	Concentration	Percentage Resistant	
		1958	1961
Chlortetracycline	10 Mcg	0.4	4.3
Oxytetracycline	10 Mcg	0.4	6.0
Novobiocin	5 Mcg	—	3.3
Penicillin	1.5 units	62.0	70.6
Streptomycin	10 Mcg	3.6	20.0
Erythromycin	10 Mcg	0	0
Chloramphenicol	10 Mcg	0.4	1.0

The new penicillin, BRL 1241 (Rollinson *et al.*, 1960), developed by the Beecham Research Laboratories is not available for veterinary use as yet, but there are a few difficulties in the way of adopting it in veterinary practice. One is the price which at the moment is prohibitive. Another factor is the reduced activity of this new penicillin. In comparison with penicillin G when tested using a penicillin-sensitive staphylococcus, it required 60 times as much BRL 1241 to produce the same inhibition of growth (Rollinson *et al.*, 1960).

It is possible that commercial development of this new penicillin will reduce its cost and bring it within the bounds of economic treatment, but its bacterial spectrum is as limited as other penicillins and it is not effective against the gram-negative organisms which increasingly are becoming important as the cause of clinical mastitis.

In addition to the antibiotics various other substances have been combined with them as adjuvants either with the idea of improving their penetration or increasing their potency.

Various enzymes such as hyaluronidase, trypsin, streptokinase and dornokinase have been, or are being, used, but the published evidence for their use is not convincing. The use of these enzymes is reviewed by Blackburn (1958).

Hydrocortisone and its derivations have also been used with the intention of reducing the inflammatory reaction and thereby shortening the period of convalescence. In one trial Monti and Ragni (1959) reported favourably on the addition of prednisone to antibiotics but they kept no controls. Where controls were kept by Keller and Boller (1959) they could find no advantage in the addition of prednisone to antibiotics in the treatment of mastitis.

A small field trial was carried out at Weybridge (1958) to evaluate the effect of adding hydrocortisone to antibiotics; 25 cases of acute mastitis which were not given any other treatment were given 3 tubes

of a mixture of penicillin, streptomycin and 25 mg. of hydrocortisone succinate; 25 similar cases were given only penicillin and streptomycin in the same manner.

Each case was evaluated 7 days after the completion of treatment and there was no difference between the groups either clinically or bacteriologically.

In addition to the selection of the antibiotic or combination of antibiotics to be used there are several other aspects of treatment to be considered. The route of administration, the size of the dose, the frequency of the treatment, the base in which the antibiotic is dissolved or suspended, and the volume of the dose if inserted *via* the teat-canal all merit consideration here.

In selecting what is the best combination of these factors the principle guiding us must be the removal of the infection and the restoration of the udder to normal function as quickly as possible. But other points have to be considered and most important of these is that the antibiotics having done their job will be excreted or absorbed from the udder as quickly as possible.

It has been shown by Uvarov and Muggleton (1954) that the base in which the antibiotic is exhibited has the greatest bearing on the retention of that antibiotic in the udder, and speaking generally it is true to say that a water-miscible base will allow quicker excretion of the antibiotic than a water-repellent base. Ullberg *et al.* (1958) have shown that there is no difference in the dispersal of the antibiotic in the udder according to the base and hence no difference therapeutically; but if the same therapeutic results can be obtained with a treatment that will not leave antibiotic residues in the milk for an extended period, then it is to be recommended.

Route of Administration

Three routes of administration of antibiotics are employed, *viz. via* the teat canal, intramuscular injections, and occasionally intramammary injections where the antibiotic is injected into the udder through the skin using a syringe and a long needle.

This last method seems to be not only futile but dangerous since in the event of the organism causing the mastitis being resistant to the antibiotic employed, the infection will readily spread along the track of the needle.

In those cases of mastitis when there is a systemic reaction, the intramuscular route of administration is indicated. If given in time this mode of treatment often produces spectacular results, but in acute cases of staphylococcal infection the interval between the onset of symptoms and treatment must be short if a complete recovery is to be obtained. Pattison (1958) has shown that staphylococci, when they penetrate into the submucosa, very quickly become walled-off in abscesses and are relatively inaccessible to antibiotics.

Not all the organisms are protected in this way, however, and the intramuscular route is to be recommended in any case of mastitis when there are systemic symptoms.

When antibiotics are injected intramuscularly for the treatment of mastitis, care must be taken that the dose is adequate so that a bactericidal level will be reached in the milk as well as in the tissues. Edwards and Haskins (1953) found that a dosage of 11 to 25 mg. per kg. bodyweight was necessary for penicillin, streptomycin and chlortetracycline. In the case of penicillin, the antibiotic was only present for a few hours, hence twice-daily injections are required to maintain a milk level of penicillin and a 10-cwt. cow would require 5 mega units of crystalline sodium at each injection. For streptomycin the injection need only be given once daily but the same level of dosage as for penicillin must be used.

Intramuscular therapy is, therefore, expensive both in money and in time and its continuous application is only justified in the most severe cases. An initial intramuscular injection followed by intramammary treatment *via* the teat-canal is often a useful compromise where it is felt that intramammary treatment alone might not be adequate.

In intramammary treatment the size of the dose employed may be important. It has been shown that a large dose will give a much higher initial concentration in the milk and hence in the milk ducts and acini, but its period of excretion from the udder will not be greatly extended except in the case of penicillin when suspended in a mineral oil and aluminium monostearate (Uvarov, 1960). There is thus little to be gained from economising in the dose and it is the experience of the author that a greater percentage of clinical and bacterial cures is obtained when larger doses of antibiotics are used.

Frequency of Treatment

Hughes *et al.* (1950) considered that it was not necessary to maintain a level of penicillin in the udder continuously, but found a greater success when an interval of 72 hours separated the treatments. In this report, however, subclinical infections were being treated, and in any case the 70 per cent. success claimed was not as good as the results attained when a continuous level of penicillin was maintained for at least 4 days in treating similar cases of *Str. agalactiae* infection (Wilson, 1952).

Whatever the antibiotic or antibiotics used it seems imperative that treatment should be continued so long as there is hope of recovery, but antibiotics should not be wasted in those cases of mastitis which are obviously not going to recover, such as a well-established case of summer mastitis.

Volume of Dose

When an antibiotic is inserted into an udder the object to be achieved is the rapid dispersal of that antibiotic throughout the udder. It has been suggested that this could better be achieved if larger volumes were used but this appears to be a fallacy.

When one considers that the capacity of many quarters is in excess of one gallon, it is difficult to see how much better penetration can be achieved by 50 ml. rather than the 1 to 5 ml. amounts which are normally used. The important point about any intramammary therapeutic is its diffusibility and this will depend to a far greater extent upon the antibiotic used and the base in which it is exhibited

than the volume which is inserted into the quarter.

An additional objection to the use of larger volumes is that this implies the use of a syringe with the possible danger of introducing a new infection rather than curing an existing one.

Summarising, in intramammary treatment, the initial selection of antibiotics to be used must give an adequate cover against both gram-negative and gram-positive organisms, the dose employed should be *more* than adequate, so treatment should take place at least once daily (with a minimum of 2 treatments irrespective of prior recovery) and the base employed should permit rapid excretion of the antibiotics from the milk once treatment has been completed. It is sound practice to treat the unaffected quarters at least once in addition to the affected quarter(s).

If a milk sample is collected prior to treatment the causative organism can be established together with its sensitivity, and the treatment of future cases occurring in the same herd will thereby become less empirical.

While most attention has been paid to the antibiotics in the treatment of clinical mastitis, other accepted treatments must be considered.

The sulphonamides have perhaps suffered from the too early advent of the antibiotics and it is possible that further consideration of their merits is justified.

A frequently used treatment for staphylococcal mastitis has been the injection of a staphylococcal toxoid and the clinical reports of the success of this treatment have been mixed. A possible explanation of these mixed results comes from the work of Plommet (1960) who tested the effect of injecting staphylococcal toxoid plus vaccine up the teat canal of cows' udders which were affected with staphylococcal mastitis. Some success was obtained when the infecting organism produced α toxin but only moderate results were obtained if the staphylococcus was producing β toxin in addition to α toxin; and since most bovine strains contain β toxin, it would not appear that staphylococcal toxoid will be a useful preparation in the majority of cases of staphylococcal mastitis.

2. Subclinical Staphylococcal Mastitis

While the clinical disease is obvious and the loss sustained easily recognised, it is in the control of the subclinical form that the veterinary profession will make a greater contribution towards reduction of the loss from staphylococcal mastitis.

There have been many attempts to define subclinical mastitis but the most acceptable appears to be that given by O'Donovan, Dodd and Neave (1960) when they defined a subclinical mastitis infection as existing when the same pathogen was recovered on a number of occasions from the affected quarter with a concomitant increase in the cell-content of the milk.

As has already been mentioned, it was shown that such a subclinical infection would result in an average reduction of 10 per cent. of the milk yield during an infected lactation.

The actual incidence of subclinical mastitis is not known. The two national surveys did not include this form of the disease, while in the survey carried out in the area around Reading by Howell *et. al.* (1961) each animal was sampled once only. Furthermore, although it was noted in this survey that there was not a good correlation between the recovery of staphylococci and an increased cell-content of the milk, it was found that 25 per cent. of the cows were infected with staphylococci at a single examination; and when one recalls that 25 per cent. of the cows had an increased cell-content as evidenced by a Whiteside fat result of $> +$ in the milk, a reasonable assessment of the incidence of subclinical mastitis associated with staphylococcal infection would be 15 per cent. of the dairy herd. Using the same method of calculation as for clinical mastitis, then the loss of milk will be 10 per cent. of 15 per cent. of the total milk sales which equals £4 million.

Such a calculation gives an overall picture of the loss to the country, but it is the loss to the individual farmer in his own peculiar circumstances which will decide what methods of treatment are justified in the fight against this form of mastitis.

Not all herds have a serious problem, but the great majority have a mastitis problem of some degree, and no dairy-farmer can afford to ignore the dangers of this disease. Klastrup (1960) in an examination of churn samples considered that 97 per cent. of the herds in South Zealand had a mastitis problem of some magnitude and this agrees well with a survey at present being carried out by Coates and Wilson on churns sent into a large collecting centre on the outskirts of London. No herd has been found which is free from staphylococcal infection, and only a very few were shown to be relatively free from subclinical mastitis.

This, then, is the position. In *every* herd there are susceptible animals and potential pathogens. It is known that some cows are more susceptible to mastitis than others and some organisms are more pathogenic than others; but the presence of susceptible or resistant animals in a herd is a chance occurrence and we do not know enough about pathogenicity to determine why some herds should be plagued with mastitis while other herds are relatively free.

It follows therefore that *every* herd is liable to have a mastitis problem and the fact that many herds appear to be free from this trouble is sometimes due to intelligent management, in many cases to chance, while in most cases the owner is feeding unproductive cows blissfully unaware of an already existing and often widespread disease condition in his herd.

Although in the ensuing paragraphs the treatment of subclinical staphylococcal infection is to be discussed, since the great majority of mastitis pathogens enter the udder *via* the teat canal in the same way as the staphylococci and are probably brought to the udder during the milking process as are the staphylococci, it follows that much of what is said for staphylococcal mastitis will also apply to other infections of the udder.

In his paper Davidson has shown how staphylococci, when they first infect a cow, do not necessarily gain immediate entrance to the milk-secreting tissues but are frequently found on the intact skin of the udder and teats where they may remain and multiply for some considerable period before they actually invade the udder tissues. It is this external infection, together with the ever-present danger of the introduction of fresh strains into the herd, that make the task of eradication of infection by treatment a hazardous one.

In the case of *Str. agalactiae*, which is not found in sites other than the bovine udder, which is unable to multiply on the intact skin and is always naturally sensitive to penicillin, eradication by treatment has been shown to be practicable (Stableforth *et al.*, 1949). With staphylococci, where external infection can persist for months, where the organisms are often insensitive to antibiotics and where treatment because of the pathological changes in the udder is frequently ineffectual even when the organisms are known to be sensitive to the treatment employed, a simple eradication by treatment can never be a practical proposition in a commercial herd. A combination of treatment plus elimination of known resistant cows might be effective for a short period, but it seems inevitable that new strains will appear.

Blackburn (1960) reported that the herd at the Hannah Dairy Research Institute had been freed of staphylococci *and* sub-clinical mastitis by treatment and elimination of chronic cases and the herd remained in this state for nearly 2 years; but recently Blackburn (1961) has found that after a number of tramped teats the disease had reappeared in the herd and 10 per cent. of the quarters are now infected with staphylococci.

It would appear from an article by Derbyshire (1960) that vaccination will not be the answer to the loss sustained from subclinical staphylococcal mastitis, since the low-grade irritation associated with a subclinical infection is not sufficient to permit the egress of the relevant antibodies to combat the infection even although such antibodies are present on the other side of the blood-milk barrier.

Since we shall achieve limited success by therapy and no success at all by vaccination, the only method left to us is to stop the infection from getting to the udders of the cows. This is a formidable project but a method has already been suggested by Wilson and Davidson (1961) of improved hygienic control of milking based on the experiments of one of them (I. D.) in a herd of identical twins kept at Weybridge, together with improved milking technique and management.

It is perhaps unfortunate that these methods can be applied at present only in milking parlours or in small bucket plants; but the main recommendation can be carried out in any plant. This is to recognise that it is the skin of the udder and teats which is the breeding ground of infection, and that the twice daily application to the *whole* of the udder and teats of a suitable disinfectant which will not be affected by organic matter and which will prevent multiplication of the mastitis organisms on the skin from one milking to the next will go a long way to reducing the level of infection to which a cow is exposed, and will thereby lessen the risk of mastitis.

The disinfection of teat clusters in a bucket-plant is not practicable since the time-honoured method of dipping the clusters in disinfectants is well recognised to be ineffective. The method of running cold water through the cluster *via* the long milk tube for 15 seconds, described by Davidson and Slavin (1958), is a much more satisfactory method but is only applicable in a parlour plant where the units are static and water taps can be provided close to each unit.

Individual udder cloths or disposable paper towels are a necessary adjunct to mastitis control and are quite practicable even in a bucket-plant if the trolley system of milking is employed, while their use presents no difficulty in a milking parlour.

Obvious precautions such as milking known clinical cases last will help to reduce the level of infection to which uninfected cows are exposed, and while it can never be hoped that cows in a commercial herd will be entirely free from infection, it is considered that the level of infection can be held within bounds and that a herd problem associated with staphylococcal infection need not exist if the hygiene precautions are adequate and the cows are milked properly with an efficient milking machine.

The so-called trigger-mechanisms of poor milking technique, faulty machines, inadequate housing and improper feeding have been already dealt with in previous publications by Wilson (1958) and Wilson and Davidson (1961) and it is necessary here only to underline the importance that management in all its aspects plays in controlling mastitis.

What appears to be needed in mastitis control to-day is a genuine effort on the part of the veterinary profession to treat this disease as a herd problem and not as a disease of the individual cow. Smith *et al.* (1960) report that the control of staphylococcal infection lies mainly in management, although due weight does not appear to be given to hygiene control.

Mastitis is a herd problem and must be tackled on a herd basis, and it is better to do this by controlling the disease *before* it has become a serious problem than attempting to repair damage which already exists. What has prevented the general adoption of herd control of mastitis has been the bottleneck at the laboratories. They are far too few in number, and in any case the cost of examining milk samples makes bacteriological testing of samples from individual cows uneconomic.

In the churn survey which has been carried out at Weybridge, samples were collected from churns and on the same day individual samples were collected from all the milking cows. Both sets of samples were examined bacteriologically and the cell counts of the churns were compared with the Whiteside results of the cows. It was found that all the infections present in the cow milk samples could be detected in the churn samples, and from the cell count of the churn milk a good indication could be obtained of whether subclinical mastitis was a problem in the herd.

In later herds the milk from all the churns was bulked and a single 1-oz. sample from this bulked milk was shown to be nearly as accurate as the churn samples, although in the same cases where the milk was collected from the bulk-collecting tank at the collecting centre, there was some carry-over of *Str. agalactiae* infection but the numbers were extremely small.

With a method which by a single examination of one sample will pick out the bad herds, most attention can be paid to these by the veterinary surgeon. If the herd is infected with *Str. agalactiae* experience has shown that it can be eradicated by treatment of infected cases and that it is economically justified.

With the other infections, such as staphylococcal infections, we are not in this fortunate position, and it is advisable at this stage to start controlling infections other than *Str. agalactiae* by adopting the suggestions described by Wilson and Davidson (1961).

Treatment of cows in these badly affected herds should be restricted to those animals either clinically affected or known to be seriously affected subclinically. The choice of antibiotics for treatment will be guided by the sensitivity tests which will have been carried out on the staphylococci recovered from the churn samples.

The detection of cows with subclinical mastitis can be carried out in the cow shed by means of the California Mastitis Test (C.M.T.) first described by Schalm and Norlander (1957). This is a simple test where a few ml. of milk are drawn from the quarter and mixed with an equal volume of an organic compound of the surface-acting type such as the alkyl sulphates and sulphonates. In this country a suitable agent is sold under the commercial name of Teepol. Jensen (1957) found the C.M.T. to be superior to the Whiteside test in detecting high cell milks.

On thorough mixing of the milk and Teepol, the mixture will become gelatinous and white flecks will appear if the milk contains an abnormally high cell-content. The test suffers from the fault that it is too sensitive, but experience helps in picking out the high cell-count milks for treatment.

A difficulty which will arise in diagnosing subclinical mastitis is that after treatment the cell-count will continue to be high for some weeks in many cases even after removal of the infection, and if the cow is in the later stages of her lactation involution of the udder will continue with a consequent high cell-count in the milk and hence a positive C.M.T. for the remainder of that lactation.

In the survey being carried out by Coates and Wilson the average cell-count of the milk in the churns is > 600,000 per ml. Klastrup (1960) in his survey in Denmark found the figure of 460,000 per ml. but found a variation in counts from 350 to 630,000 per ml. These figures are average figures, but in the British survey over 20 per cent. of the churns contained milk with > 1,000,000 cells per ml. This is far from satisfactory, and undoubtedly mastitis—much of it staphylococcal—is the cause.

An improvement of this position will not be easy but the solution represents a challenge to the veterinary profession. Prophylaxis and not therapy should be our aim, and by adopting the methods suggested we can then hope to achieve our object of reducing the loss from mastitis and providing the general public with a liquid which is milk and not diluted pus, and which is free from noxious additions such as penicillin.

Mastitis control does not lie in the antibiotic tube nor need it be neglected for want of adequate laboratory facilities. In a disease which is essentially a bacterial infection and which is spread from cow to cow during milking in the majority of cases, it follows that a rigid system of hygienic control *continuously* applied will go a long way to reducing the risk of cows becoming infected, and this risk wil be further reduced if cows are milked efficiently with a well maintained milking machine.

References

BERGER, J., & FRANCIS, J. (1951). *Vet. Rec.* **63.** 283.
BLACKBURN, P. S. (1958). *J. of Dairy Research.* **25.** 486.
———. (1960). *The Dairy Farmer.* April. p. 30.
———. (1961). Private communication.
COATES, W. A., & WILSON, C. D. (1961). Unpublished data.
DAVIDSON, I., & SLAVIN, G. (1958). *Vet. Rec.* **70.** 893.
DERBYSHIRE, J. B. (1960). *Res. Vet. Sci.* **1.** 350.
EDWARDS, S. J., & HASKINS, MARY D. (1953). *J. Comp. Path.* **63.** 53.
HOWELL, D., WILSON, C. D., LEACH, F. B., & VESSEY, M. A. (1961). In press.
HUGHES, D. L., CHRISTIE, G. J., & FARMER, R. K. (1950). *Vet. Rec.* **62.** 11.
JENSEN, P. T. (1957). *Nord. Vet. Med.* **9.** 590.
KELLER, H., & BOLLER, H. (1959). *Schweiz. Arch. Tierheilk.* **101.** 444.
KLASTRUP, O. (1960). *Nord. Vet. Med.* **12.** 621.
MILK MARKETING BOARD. *Rep. of Prod. Div.* (1956-57). **7.** 88.
MONTI, F., & RAGNI, M. (1959). *An. Fac. Med. Vet., Torino.* **8.** 193.
O'DONOVAN, J., DODD, F. H., & NEAVE, F. K. (1960). *J. of Dairy Res.* **27.** 115.
PATTISON, I. H. (1958). *Vet. Rec.* **70.** 114.
PLOMMET, M. (1960). *An. Inst. Pasteur.* **99.** 618.
REF. ON THE ANIMAL HEALTH SERVICES IN GT. BRITAIN (1958). p. 44.
REPORT ON DISEASE WASTAGE AND HUSBANDRY IN THE BRITISH DAIRY HERD (1957-58). p. 37.
ROLLINSON, C. N., STEVENS, S., BATCHELOR, F. R., WOOD, J. C., & CHAIN, E. B. (1960). *Lancet* Sep. 10th., 564.
SCHALM, O., & NORLANDER, D. O. (1957). *J. Amer. Vet. Med. Ass.* **130.** 199.
SMITH, F. F., MCKAY, K. G., NORLANDER, D. O., & GRAY, D. M. (1960). *Proc. 63rd Meeting of U.S. Livestock San. Assocn.* 1959. p. 171.
STABLEFORTH, A. W., HULSE, E. C., WILSON, C. D., CHODKOWSKI, A., & STUART, P. (1949). *Vet. Rec.* **61.** 357.
ULLBERG, S., HANSSON, F., & FUNKE, H. (1958). *J. Amer. Vet. Med. Ass.* **134.** 155.
UVAROV, O., & MUGGLETON, P. (1954). *Vet. Rec.* **66.** 200.
———. (1960). *Ibid.* **72.** 1,228.
WILSON, C. D. (1952). *Ibid.* **64.** 425.
———. (1958). *Ibid.* **70.** 159.
———, & DAVIDSON, I. (1961). *Ibid.* **73.** 321.

THE SPEAKERS' INTRODUCTION

The Chairman, Mr. I. H. Pattison, said that it seemed very appropriate that the scientific section of the Congress of 1961 should begin with a symposium on bovine mastitis, because the time was more than ripe for bovine mastitis to come back into the field of research. It was 7 years since a paper on mastitis had been delivered at Congress, and the apparent lack of interest in it might indeed be a true reflection of the feeling that was abroad that all that

could be done in research into bovine mastitis had, in fact, been done, and that it was a disease associated with high milk production; there was nothing very much, therefore, that could be done about it. That was why he was glad that the organisers of the Congress had given an opportunity of bringing the disease once more back into the public eye.

He was happy that all research workers did not have that feeling about bovine mastitis. There were on the platform 3 enthusiasts and 3 experts whose brains he hoped would be picked. There were Mr. C. D. Wilson, of Weybridge, who was already known to those present as an expert in the field control of the disease; Mr. I. Davidson, also from Weybridge, who had found out a great many interesting things about the epidemiology of staphylococcal mastitis; and Dr. J. B. Derbyshire, from Compton, who had made interesting and significant contributions to the solution of some of the problems associated with immunity to bovine mastitis. There could not be three better people to keep the audience entertained and instructed until 4.30.

He then called on Mr. Davidson to give his paper on "The Epidemiology of Staphylococcal Mastitis."

Mr. I. Davidson, presenting his paper, said that in milking hygiene was a powerful weapon which, when taken together with good management and intramammary treatment, should effectively control staphylococcal mastitis in most herds. He proposed to highlight the chief features in the paper and go on to discuss some of the difficulties which might arise when applying them in practice.

Good milking hygiene had an important part to play in the control of staphylococcal mastitis, which fact was based on the following ecological factors in the paper.

Firstly, the main reservoir of mastitis-producing staphylococci was in adult cattle. Secondly, although the staphylococci were not obligatory intramammary parasites (they were not confined to the udder) and could maintain themselves in a number of sites remote from the udder, the most important sites were the milk-secreting tissue of the udder and the skin of the udder and teats. Therefore, the two main sites were intimately associated with the udder itself. Although the staphylococci could exist in other sites, they did so less commonly and were less persistent. Two slides were shown to illustrate this. Although in many cases, the staphylococci could live on the skin without producing any visible lesions they did, on occasion, produce small superficial pustules. The first slide showed pustular dermatitis of the udder. The lesions began as small pus-containing spots very often further surrounded by a ring of oedema.

The next main site, which was less common, was the perineum, where the infection usually lasted for a shorter time, though it could be quite severe. The second slide illustrated this, showing pustular dermatitis extending around the anus and vulva of the cow. It sometimes extended to about half-way down the tail and was confined to areas of skin only thinly covered with hair.

He emphasised that the staphylococci could live and multiply and build up enormous numbers, particularly on the udder skin without causing visible pathological change. Far from the staphylococci being ubiquitous, they had, in common with most other organisms, a restricted habitat.

The staphylococci were found almost exclusively amongst adult cattle, seldom in the young animals, which became infected when they went into the milking herd. Within the milking herd, they were found chiefly in and on the udder.

From that, it would seem that the chief means of spreading the staphylococci were likely to be the various agents used in milking, and the infection was most likely to spread from udder to udder primarily at milking time. It was reasonable to suppose that if sufficiently rigid hygienic precautions were applied at milking time to prevent transfer of the infection, there would be achieved some effect in controlling staphylococcal mastitis. He had shown in the paper that that was indeed so, and by suitable hygienic precautions at milking time, the rate at which the staphylococci were disseminated from those two important sites could be substantially reduced.

He had taken it for granted that, when dealing with a staphylococcus problem in a herd, any faults in management or milking technique which could be detected would be first of all put right, and he did not wish to discuss that aspect further. He had described the necessary hygienic precautions in the paper in detail.

When those were applied in practice, certain difficulties might arise. Firstly, the effect, if any, of those hygienic precautions on other mastitis pathogens, if those precautions were applied, was not known. It was possible that, although they might be successful in reducing the amount of staphylococcal mastitis, it was conceivable that other kinds of mastitis might continue. It was possible that the methods might come into disrepute if it was not clearly understood that they were specifically directed against staphylococcal mastitis. One would imagine that the precautions would have some effect on other mastitis pathogens. He therefore wished to emphasise that the precautions had been devised specifically for staphylococcal mastitis.

In the present state of knowledge, intramammary treatment had a low rate of success. That had to be put into perspective. Since the known methods of intramammary treatment had such a low rate of success, one was faced with the problem of always having, or very probably having, persistence of infection within the udder in a number of cows in the herd. The methods available at present were not sufficient to deal certainly with every cow which had an intramammary infection of staphylococci and that meant that it was very difficult to eliminate that infection altogether from a herd.

However, improved methods could be hoped for in the future, and the hygienic methods outlined in the paper would prevent reinfection in cows which it had been possible to treat successfully and would reduce the rate at which infection spread from the remaining infected cows; they would therefore give the best possible background to apply intramammary treatment or any other form of treatment in that successes were likely to be real and permanent, not transient.

Dr. J. B. Derbyshire first thanked the Provisional Committee for inviting him to give a paper on immunity at the Symposium. He was happy to accept the invitation for 2 reasons: firstly, there was at present considerable interest in staphylococcal immunity, mainly in the medical field. He welcomed the opportunity of giving a review of the situation in immunity in staphylococcal infections to a veterinary audience.

Secondly, he felt that, from time to time, veterinarians in clinical practice, must ask themselves whether anything could be done to increase the resistance of the cow to the disease by means of vaccination.

He proposed to introduce his paper by trying briefly to answer that question as fully as he could.

In a single sentence, the answer was that there was no vaccine which would prevent all degrees of staphylococcal mastitis caused by all strains of staphylococci.

Amplifying that a little, he proceeded to give the reasons why that seemed to be the present situation, and to try to assess what hope there was that, in the future, such an efficient vaccine might be developed.

Firstly, the nature of the disease had to be considered; of relevance was the observation that the mammary epithelium of the cow was only permeable to the passage of circulating antibody when some degree of mild inflammation was present in the udder. That meant that a successful, efficient vaccine might be expected to prevent severe forms of mastitis but might not prevent a mild, low-grade subclinical infection of the gland.

That led to the consideration whether local vaccination of the udder might not be a more efficient means of control than systemic vaccination. One drawback to such a procedure was that a vaccine injected into the teat canal would probably be highly irritant to the mammary tissue. Secondly, no experiment which had so far been reported on udder vaccination had accurately differentiated between specific immunity and a non-specific increase in resistance. In recent experiments, he had shown that quite a mild irritant could considerably increase the non-specific resistance of the udder; that was the simple technique of inoculating distilled water into the udder some hours before an injection of staphylococci. Such procedure in a

considerable proportion of cases prevented any severe mastitis. The distilled water produced a rather mild inflammatory response so that the tissue defences were mobilised and better able to cope with the bacteria which came along later. The effect was quite transient.

Turning to a consideration of some of the characteristics of the staphlococcus itself, which made this a particularly difficult organism from the aetiological point of view, it was now many years since the production of a fairly potent toxin by staphylococci was first demonstrated. That had been at the time when the use of toxoid in the control of diphtheria in man was having very marked success. At that time, it seemed hopeful that staphylococcal infections might be controlled equally successfully by the prophylactic use of toxoid. Unfortunately, that hope had not been fulfilled.

The present situation was that staphylococcal toxoid would give a high level of protection against mastitis but only against mastitis caused by certain strains of staphylococci. It was now known that other strains occurred which would produce very severe purulent mastitis in animals with a high level of anti-toxic immunity.

The staphylococcal cells themselves had received very little attention from the immunological point of view. It appeared that whole staphylococcal cells had little immunising power and work on antigenic fractions prepared from disrupted bacteria should continue, since the small experiments that had been done along those lines had given some indication of success.

In addition to the alpha toxin there was also a variety of other toxins and diffusible products which had been described more recently, and some might be of importance as immunising antigens. He was thinking particularly of coagulase, hyaluronidase, staphylokinase, and leucocidin, which were antigens on which very little work had been done from the immunisation viewpoint. It was an important field for further studies.

Linked with the problem of how to prepare a staphylococcal vaccine was the question of how such a vaccine should be tested. Clearly much useful information could be gained from experiments with small laboratory animals, but it should never be assumed that a vaccine which would protect against staphylococcal infection in a rabbit would protect against mastitis in a cow. Field trials with cattle were even more unsuitable when the problem was one of testing and comparing a large number of vaccines in different ways for immunising power. Experimental studies in cows were expensive on that sort of scale.

He had indicated in the paper that what seemed to be a logical approach was to conduct initial screening tests of vaccines prepared in different ways, in mice, to pick out those which seemed to have some immunising value, test them experimentally in goats and finally conduct trials in cattle of any vaccine which had withstood the preliminary trials.

That kind of work took a considerable time, particularly when a large number of antigens was involved in such tests.

With regard to what hope there was in the future that a staphyloccal vaccine might be developed, there were those who regarded the hope as particularly forlorn, basing that conclusion on the evidence of recurrent infections with staphylococci in man and animals. He believed that view to be somewhat over-pessimistic and unjustified because there was equal or greater weight of evidence that, under certain conditions, immunity to staphylococci could develop and could be demonstrated.

There was very considerable current interest and activity along the lines indicated in the paper, and that work gave considerable hope of practical results. It appeared that the simpler classical procedures for preparing vaccines from staphylococci had been exhausted but the staphylococcus presented a challenge to new ideas and techniques which was not being ignored.

Mr. C. D. Wilson said that it was a great honour to have been asked to give a paper to the British Veterinary Association. It meant recognition of one's work, which he hoped would be echoed in the ensuing discussion. He had tried to make his paper provocative in some ways and hoped that it would stimulate discussion.

He had divided his paper into 2 sections: clinical mastitis and subclinical mastitis. Subclinical mastitis was probably by far the more important. It was obviously not so spectacular and not something that practitioners met every day, but economically, it was the more important.

Various surveys had been carried out to try to determine how much mastitis existed in the country to-day, not confined to staphylococcal mastitis but mastitis in general.

As many people would be aware, there had been 2 national surveys carried out. One was carried out by the Animal Health Division on disease of farm animals. It was found that 10.5 per cent. of the animals in Britain would have mastitis in a year. Almost at the same time, a survey was carried out by the Milk Marketing Board in association with the National Institute for Research in Dairying. It was found that on any one day, 1 per cent. of the cows in the national herd would be found to have some form of clinical mastitis. Both those figures were gross underestimates.

A survey had also been carried out on all the machine-milked herds within a 10-mile radius of Reading, not relying as the other 2 surveys had done, on the diagnostic ability of laymen. A veterinary surgeon examined the cows clinically, and collected and examined milk samples, the Whiteside test and bacteriological examination being carried out at the laboratory. He felt that a very close examination had been carried out and a figure obtained that would stand up to criticism. On that survey, it was found that, on any one milking—not on any one day—the percentage of cows in a herd which would be suffering from clots in the milk was 5, the milk being visibly abnormal even to the casual observation of a cowman, or which should be so visible.

Recently, he was looking for a herd which he hoped would be suitable for work on which he was engaged. He had asked the farmer whether his herd could be used. The reply was "You can, but we have not got mastitis. I doubt if we have used a box of penicillin in 6 months." Eight clinical cases had been found on examination of the cows; when 55 cows were examined bacteriologically, 40 were found to be infected with streptococcal mastitis. That was the kind of information inquiries would get from farmers—quite honest information but obviously completely wrong.

In dealing with the treatment of clinical mastitis, one of the things that was strikingly apparent at present was the increasing resistance developing amongst staphylococci to antibiotics. That was striking in the case of pencillin. Every 2 years at Weybridge, 500 strains of staphylococci had been taken, which were recovered from cases of clinical mastitis, and had been run through for sensitivity to various antibiotics. Initially, 3 methods of determining sensitivity had been compared. All 3 methods gave results which were comparable so there could be no criticisms in terms of technique. It had been found to date that 70.6 per cent. of the strains from clinical cases of mastitis were resistant to penicillin. What was perhaps more worrying was that in the case of streptomycin, resistance had jumped from 3.6 to 20 per cent. in 3 years. The other antibiotics showed an increase with the exception of erythromycin.

At present, it did not appear that the new penicillin evolved by Beecham was going to be any better. It was vastly expensive and took 50 times as much pencillin of the type BRL 1241 as ordinary penicillin when treating sensitive strains. It would therefore be uneconomic to use the so-called "wonder" penicillin.

With regard to the treatment of clinical cases of mastitis, there had been three routes of administration used. One of them was not used much nowadays—where the needle was actually injected right into the substance of the udder.

On the question whether to carry out treatment *via* the teat canal or by intramuscular injection, one had to make the decision on the basis of the clinical case being treated, the severity of the case and the character of the udder. In acute cases of mastitis with oedema, the chances of getting good diffusion of antibiotics were small. When intramammary preparations were injected into the udder, they ascended through the udder almost entirely *via* the duct system. If there was a blocked duct system, such as

in an oedematous udder, diffusion was very poor indeed. That was not the case with intramuscular injections provided an adequate dose of antibiotic was used to get across the blood-milk barrier. Use of that route gave a better and more even diffusion of the antibiotic in cases where the ducts were involved through oedema or where the ducts were blocked by proliferation of the duct epithelium.

There had recently been a publication in which the author had extended the work done by others on the use of radioactive penicillin. Irrespective of whether a low volume or high volume was used, the same diffusion was obtained in the udder. His own feeling was that the use of large volumes was unnecessary. It was sad to have to admit that no one really knew what was the optimum dose of penicillin.

When the work was carried out at Weybridge of finding the dose of penicillin, the concern was not with the clinical case but with the bacteriological infections. It was found that it was not so much the size of the dose which was important but rather the length of time the antibiotic was acting in the udder. For various reasons, more particularly because medical people were becoming worried at the presence of antibiotics in milk, it seemed that a high level of penicillin in the udder for as short a time as possible was required. The first duty of the veterinarian was to the patients and to get them better by the best means available but if that could be done and at the same time the milk be returned to a usable condition for human beings in the shortest possible time, that was the line that ought to be taken. The possibility of using antibiotics which gave high diffusion rate and rapid elimination should be considered. What had still to be proved was that the new types of antibiotic would do as good a job as the longer-acting ones.

Referring to subclinical staphylococcal mastitis, O'Donovan, Dodd and Neave showed that a cow with subclinical staphylococcal mastitis would lose 10 per cent. of its anticipated yield in an infected lactation. They defined a subclinical mastitis infection as existing when the same pathogen was recovered on repeated occasions from the affected quarter with a concomitant increase in the cell-content of the milk. On that basis, they found that 10 per cent. of the anticipated yield would be lost.

On the point of the incidence of subclinical mastitis in the survey carried out from Reading, it was found that 25 per cent. of the cows were infected with staphylococci at a single examination.

Another survey had been carried out in the Basingstoke area covering 200 herds and the average infection of staphylococci was found to be 44 per cent. The herds were examined once only. With those infections, there was not always an association with a high cell content in the milk. It was felt to be true to say that some 15 per cent. of dairy cattle to-day were suffering from subclinical mastitis associated with staphylococci.

If that figure was taken, in terms of loss of milk yield from that disease alone £4,000,000 a year was being lost. Something had to be done to restore that lost milk to the farmer.

Mr. Davidson had spoken of the work he had done on the epidemiology of staphylococcal mastitis. From that work had developed a field trial where an attempt was being made to see whether, by means of a combination of good hygiene and good milking technique, something could be done to reduce, first of all, clinical mastitis and, secondly, the subclinical mastitis in herds.

One of the greatest snags about any mastitis control problem had always been the difficulty of examining milk samples. It would be impossible to provide facilities throughout the country to examine milk samples from every cow. The possibility had been studied of examining churn samples and, latterly, of taking the bulk milk from the herd. By the examination of one bulk sample, it could be discovered (a) the type of infection in a herd and (b) the extent of the infection and whether that herd would have a mastitis problem or not. As a result, it was now possible, by using that method, to pick out the herds which were really having trouble and go out to them and do something in the way of attempting to control the disease.

It was hoped to start such an experiment at Weybridge, to see what the possibilities were, by using the churn samples and the bulk samples, of checking the amount of mastitis in the herd.

Mr. Davidson had not specified the hygienic methods used and he thought that should be done because it was very difficult to achieve asepsis in a cowshed, but a great deal could be done to limit the amount of infection in a herd.

There were 3 things which were the obvious source of the infection: the hands, the udder cloths and the teat clusters. Those were the main factors of infection from cow to cow.

Sterile udder cloths should be used. Some might think that that was not a practical proposition. An alternative was to use individual disposable paper towels once and then discard them.

Teat clusters were always a most difficult thing to disinfect. The old-fashioned method of dipping the clusters in a bucket and praying the infection would be removed did not work; a lot of infected milk was still retained.

A method had been developed at Weybridge by which cold water was run through the cluster for 15 seconds which removed a considerable amount of infection. Yet another method was, instead of using cold water, to suck nearly boiling water at 90°C. through the cluster for 6 seconds. That method was almost 100 per cent. effective and worked quite well. Cows' teats seemed to be much less tender than human hands because the clusters could be put back on the cows immediately without any reaction on the part of the cow.

He concluded by giving the position of the milk supply from the churn survey. From one of the large creameries in London, it had been discovered that the average cell content of the milk arriving at the creamery was over 600,000 per ml. That was not an out of the ordinary figure. Klastrup, in his survey in Denmark, found the figure of 466,000 per ml. It had been found in Britain that over 20 per cent. of the churns contained milk with more than 1,000,000 cells per ml. That was not milk at all; it was diluted pus. It was a challenge to the veterinary profession. The milk was like that because of mastitis. It was up to the veterinary profession to do something about it.

The Chairman said that it was regrettably easy for a research worker to forget the pioneers in his subject. A research worker was very inclined to live in a little world of his own and forget the people who, 10, 20, 30 years ago, were present at the creation of that world. He asked the audience to cast their minds back over 30 years of research on mastitis to the year 1929, when the first of a brilliant series of papers had appeared, in which the organisms associated with mastitis were classified and the disease itself was defined; in particular, to a paper in that series that appeared in 1933, which describes a selective medium for the culture of mastitis organisms, which simplified enormously the work of people interested in that field. The names of the authors of the paper in 1929 were F. C. Minett, A. W. Stableforth and S. J. Edwards. The name on the paper describing the selective medium was S. J. Edwards, and S. J. Edwards was the first man in the world to observe the lethal effect of penicillin on the mastitis streptococcus. He was proud to be able to say that S. J. Edwards was a colleague of his at Compton and to introduce him as the opener of the discussion.

The Opener

Dr. S. J. Edwards thanked the Chairman for his complimentary remarks. A great deal of progress had been made since those early days, in particular in the field of chemotherapy. He thanked the authors for their excellent papers and the clear presentation they had given that day.

The subject before the meeting was not the broad field of mastitis but one particular aspect of it, namely the aspect of staphylococcal mastitis.

Since the subject of bovine mastitis was discussed 7 years ago the increasing importance of staphylococci in the causation of the disease had been recognised. Members of the profession had also been able to study the nature and epidemiology of the organism more closely and they had made a beginning in a critical study of developing immunity against infection. It would be a mistake however, to think

that this organism was the only cause of disease even in those herds which had been freed of *Str. agalactiae*, formally isolated from the majority of clinical cases.

In the speaker's experience staphylococcal infection had assumed the previous rôle of that due to *Str. agalactiae* and they now found that the 3 dairy herds at Compton were heavily infected with this organism. Under these circumstances it was not surprising to find that *Staph. aureus* was the principal cause of clinical mastitis, although a similar incidence of disease was caused by the *Streptococcus* species, *Str. dysgalactiae* and *Str. uberis*.

Incidence. During the last 10 years Dr. Edwards had been able to collect fairly accurate data on the incidence of clinical mastitis due to various organisms in these herds. They contained about 330 milking cows, and 1,067 cases of mastitis had been recorded from them. The total number of clinical cases due to different organisms and the incidence of the different infections was shown in Table I.

TABLE I
CAUSATIVE ORGANISMS AND ANNUAL INCIDENCE OF CLINICAL MASTITIS (1951-60).

Infection	*Staph.*	*Str. dysgal.*	*Str. uberis*	*Coryn. pyog.*
No cases	445	262	261	52
	41.8%	24.5%	20.2%	4.9%
Annual % incidence	13.5	8.0	6.6	1.6

Infection	*Bact. coli*	*Str agal.*	*Others*	*Neg.*	*Total*
	28	16	7	41	1067
	2.6%	1.5%	0.7%	3.8%	
Annual % incidence	0.85	0.5	0.2	1.25	330 cows

It could be seen that staphylococci were responsible for the largest number of clinical cases but that the incidence of disease due to the streptococci was slightly greater. When these figures were compared with those given by Mr. Wilson it was found that the annual incidence due to staphylococci alone was greater than that given by him—namely 10 per cent. for the total incidence, a figure which Dr. Edwards understood Mr. Wilson thought was too low. According to Dr. Edwards's data, the loss due to staphylococcal mastitis alone could be estimated at £3 million annually and the total loss due to all forms of mastitis about £5 to £6 million—a figure agreeing with that given by Professor Beveridge and obtained by him from the Ministry of Agriculture returns for 1959. At the same time about £1 million was spent on antibiotics for treatment which must have some effect on reducing this estimated loss.

Influence of milking technique. Dr. Edwards had found that although the staphylococcal infection rate in his herds was about 60 per cent, the clinical rate varied from 6 per cent. in one herd to about 18 per cent. in the other 2. It was difficult to account for this variation since all 3 were well managed, but he was of the opinion that the milking technique was more efficient in the herd with the lowest incidence of mastitis. Here the cows were prepared for milking by applying a separate warm cloth to each cow and the clusters were applied soon afterwards. Machine stripping was carried out very carefully under the supervision of a conscientious head dairyman with the result that very few cases of mastitis occurred during the lactation period; they usually occurred soon after calving. In the other 2 herds the same care was not taken and milkers tended to adhere to a strict 4-minute milking period with the result that some cows, more especially older cows with large udders, might not be properly stripped. This in turn accounted for the occurrence of clinical mastitis over the whole lactation period.

A slide was then shown of a technique for stimulating "let down" before milking. A separate warm cloth for each cow was applied before milking, the cloth being newly sterilised and placed in a bucket of warm water. That was important because cows let down their milk much better by that technique and the milking could be done in a reasonable time. If one milker looked after no more than three units, it enabled the units to be applied soon after washing. Each milker first washed three cows and then applied the units to those three cows. He then washed the udder of a fourth cow. By the time that was done, the first unit was ready to put on to the fourth cow.

Dr. Edwards would like to support Mr. Wilson's view that a proper milking technique was a major factor in the management of the cows so far as avoiding mastitis was concerned. The evidence regarding the influence of the machine *per se, i.e.*, in respect of vacuum and pulsation in the causation of mastitis was, in his opinion, contradictory, but his observations made him think that improper usage might lead to disease. It was difficult to strike a correct point between too short a milking time with insufficient stripping and too long a period leading to over stripping and possible teat erosion. Efficient stripping seemed to be the hallmark of a good attendant who could often tell by manipulating of the quarter or even by the look of the udder when this stage had been reached rather than by observing the glass window in the milking tube. With cows having large udders and teats this was usually quite clear whereas, by applying presure to the claw, quite a lot of milk could be removed.

Characters of the staphylococci. During the last few years more attention had been paid to investigating the staphylococcus especially by sensitivity to phage which, together with other tests, had enabled veterinary surgeons to differentiate bovine staphylococci into several species. Dr. Edwards believed that phage typing alone gave too complex and confusing a classification although it was a useful preliminary method of studying the epidemiology of staphylococcal infection. Other characters were more important in distinguishing the pathogenic types within the species such as coagulase and haemolysin production as well as their virulence and toxicity.

The speaker had studied the phage types of staphylococci that had been present in the herds at Compton during the last 10 years and he had found that each herd harboured not more than 2 or possibly 3 types at one time, and that the total phage types encountered in the herds had been 13. Throughout this period new types had appeared in 2 of the herds, but in the third there had been no change from type 42D which had also been found as a prevailing type by Dr. Williams Smith.

This picture was more confined than the one presented by Mr. Davidson for a herd in which he had isolated some 70 different strains and types in a period of 6 years with a predominance of 13 of them. Dr. Edwards would ask him if he could explain this difference by the fact that his experimental herd was not self contained, and that he was frequently changing personnel which, as Mr. Davidson had shown, could introduce new types of staphylococci.

The speaker had observed that phage types entering or leaving the herds might be penicillin sensitive or resistant and that penicillin resistance, which denoted the ability to produce the enzyme penicillinase, was a specific property of certain species of staphylococci. There was also a correlation between phage type and sensitivity to penicillin, and so far Dr. Edwards had not found that penicillin resistance was induced within an existing type in a herd as a result of using this antibiotic for treatment. This view was supported by his earlier work in which he had found that the injection of penicillin on 22 consecutive occasions into the infected quarter of one cow did not induce resistance to this antibiotic.

Distribution and Resistance of Staphylococci. Both Mr. Wilson and Mr. Davidson had made statements about the nature of the bovine staphylococcus with which Dr. Edwards found it difficult to agree. Mr. Wilson, in comparing staphylococci with *Streptococcus agalactiae* stated that the latter organism was not found in sites other than the bovine udder, and Mr. Davidson credited the staphylococcus with a rôle other than that of an obligatory parasite because it appeared to survive (and presumably multiply) for long periods outside the udder. Now *Str.*

agalactiae had been found in many sites other than the udder, in fact in all positions on the cow or her surroundings which infected milk either directly or *via* the agency of the milkers could come into contact. Dr. Edwards had found that the typical bovine staphylococcus (type 42D) had the same distribution as *Str. agalactiae*, being found on the surface of the teats and udder, teat cups and milking hands. Its survival was about the same as that of *Str. agalactiae* when applied to the teats of the dry cow where it could be found for 6 to 9 days. Also, when milking cows were treated in isolation with continuous doses of penicillin the organism disappeared fairly quickly from the teat surface. Thus, it was not adequately proved, in his opinion, that the distribution and survival of the bovine staphylococcus differed greatly from that of *Str. agalactiae*. Further information on this point was desirable as it was fundamental to any scheme for the effective control of infection.

Eradication. Dr. Edwards agreed with Mr. Wilson that a simple scheme of eradicating staphylococci was not available at the present time. In his opinion this was due to the fact that it was very difficult to reduce the high incidence of infection—up to 60 to 80 per cent.—which might be present by such simple measures as needed to be practised for eradicating *Str. agalactiae*. For this purpose penicillin had an efficiency of 90 per cent. and in most herds infection could be eliminated by using disinfectant in the washing water for a short time to supplement treatment. On the other hand, the speaker had found that penicillin was only about 70 per cent. effective in eliminating staphylococci in an experimental herd even when assisted by more stringent precautions than those advocated by Mr. Davidson, while in a commercial herd reinfection took place so rapidly that treatment of infected cows seemed to be of no assistance.

If a suitable antibiotic or other substance more potent than penicillin for reducing the weight of infection (especially of penicillin-resistant varieties) could be found, then the supplementary measures recommended by Mr. Davidson would no doubt be of value provided they did not impede too much the routine at milking time which in most commercial herds was carried out to a stricter time schedule than that which could be allowed in an experimental herd.

In the meantime, Dr. Edwards thought the profession could best combat staphylococcal mastitis by paying strict attention to the milking technique, together with the early treatment of clinical cases. This was the method he had been trying to adopt in the herds at Compton where, in spite of a fairly high clinical rate of 18 per cent. in 2 herds, the average milk yield of the cows had been maintained at 880 gallons which compared favourably with the national average. In adopting this procedure they had to take into account the costs of continuous treatment which must of course be balanced against those of using disinfectant daily, and the fact that they were not achieving the ideal of eradicating infection. On the other hand, it seemed to him that the profession must also consider the desirability of freeing herds from staphylococci for the following reasons:—

(a) Cows possess a basic antitoxic immunity to the prevailing types of infection.

(b) This infection does not cause severe mastitis and is usually responsive to antibiotic therapy.

(c) The elimination of such infection might pave the way to invasion of some other species of organism or another staphylococcus producing a more virulent form of mastitis.

Immunity. This brought Dr. Edwards to the general question of immunity which Dr. Derbyshire had discussed fully in his paper. In the first place it was more possible to think of developing an immunity to the staphylococci than to the streptococci since most types of the former were toxin producers. Secondly, the presence of antitoxin in the blood and milk could indeed be detected as the result of natural infection. Also, the antitoxin level both in the blood and colostrum or milk rose when there was mastitis so that, although the presence of antitoxin did not prevent mastitis, it might reduce its severity. Again, in herds where there was a high infection rate he had found that the majority of cows possessed antitoxin in the blood and that clinical mastitis in these herds was not severe but took the form usually of a subacute disease at calving.

It therefore seemed to him that there was a case for vaccination in herds, especially in the dry cow where one hoped to get a very high level of antitoxin to prevent her contracting mastitis at a time when she went straight into the shed immediately after calving. That was a time when a lot of cows went down with the disease.

Derbyshire in his experimental work with goats had also reduced the severity of experimental mastitis when the test inoculum had been sufficient to cause gangrenous mastitis in controls—a form of disease rarely seen naturally with the type of staphylococcus (strain 201 and type 42D) he was using. He had shown that immunity is type-specific but this did not seem to be a disadvantage since, as Dr. Edwards had said earlier, there were usually not more than one or possibly two predominating strains in a herd so that an autogenous vaccine could be prepared for each herd. Also, the speaker felt that such immunity as could be provoked to 42D strains should not be subjected to challenge by 78 type strains which were rarely encountered and were essentially less toxic but more virulent than 42D strains.

Dr. Derbyshire had mentioned the development of local immunity in the udder following local injection of antigens and had questioned if the increased resistance was non-specific. In this respect, Dr. Edwards had always thought that a profitable line of enquiry lay in this field since it was known that non-specific chemical substances like "lactenin" present in milk do have an inhibitory action on bacteria. In conversation with Professor Richards recently he had gathered that work at Cornell had shown that a lipid substance could be formed by desquamated cells at the teat orifice which could protect against experimental infection. It might be that a study of these substances by the immunologist and biochemist might yield a better line of approach to developing protection of the udder, than by the more conventional antigen-antibody response developed after parenteral infection.

The General Discussion

Mr. Wilson, in reply, referred to the difference between staphylococci and *Streptococcus agalactiae*. He said that the difference was that the staphylococci could grow and multiply on the intact skin whereas it had been shown that the *Streptococcus agalactiae* could not do so. It was comparatively simple to eradicate *Streptococcus agalactiae* from an infected herd provided reasonable antiseptic precautions were taken to remove the infection. Although in an infected herd, it had been shown many years ago that infection could occur in many sites, it would die out provided it was not replenished from infected udders.

Mr. Davidson, in reply, referred to the distribution of *Streptococcus agalactiae*. The point was that staphylococci would grow and multiply in many sites other than the milking tissues of the udder on intact skin. The mere finding of streptococcus on intact skin did not mean that it multiplied there, whereas *Staphylococcus aureus* did.

On the subject of phage typing, he had been using that technique merely for epidemiological purposes as a technique of labelling different strains of staphylococci so that he could follow them through the herd over a period of years to see what happened. That he found 70 different phage patterns during 6 years whereas Dr. Edwards found 13 might be explained by the fact that he himself was taking samples from all external orifices, from several skin sites, from milkers' hands and laboratory workers' hands. Many of the 70 had never been recovered from milk at all but were found only in the other sites.

On the question of the correlation between sensitivity to penicillin and other properties of staphylococci, the position was, as many workers would agree, that within a particular closed community, such as a herd of cows, there was usually a complete correlation between phage sensitivity, antibiotic sensitivity, etc., but that correlation did not hold for staphylococci in general. When one left that closed community, the correlation broke down. All it meant was that within the closed community there was a restricted number of strains. Any one strain had a particular combination of properties, but in the world at large, there was

a wide variety of strains having many different combinations of properties.

With regard to the application of the particular techniques of good milking hygiene in commercial herds, he felt strongly that the techniques he had put forward were simple techniques which any moderately intelligent farmer could apply with profit. It would be a great mistake to say that one should not try to reduce the total amount of staphylococcal infection in a herd simply because the techniques were a little unusual and farmers were not used to them. Furthermore, it was a mistake to say that one should not try to reduce the amount of staphylococci in the herd for fear of getting a more virulent strain in. His firm opinion was that if the techniques were applied, the entry of other strains of staphylococci would be made less likely and not more likely.

Dr. P. S. Blackburn (Hannah Dairy Research Institute, Ayr), congratulated the speakers on the close integration of their papers. It seemed that progress was at last being made with staphylococcal mastitis.

Mr. Davidson had spoken of the closed community. On the point that it was rare for a human to carry the infection to the herd, the self-contained herd would usually remain a closed community except on rare occasions; he presumed that that meant infection carried by people working with the herd and not by people from outside.

He was interested in the point that a new staphylococcus appearing in a herd would in time cause mastitis and presumed that that meant the staphylococci found on the skin. He would say that a staphylococcus found in the udder not causing mastitis would, in time, adapt itself and cause mastitis. That seemed to happen in his own herds. He was finding a great many quarters infected with staphylococci but not showing mastitis, after the staphylococci causing mastitis had been cleared. It was some time before mastitis occurred. He did not type the organisms but thought it probable that they had become adapted to cause mastitis.

With regard to treatment, he had stopped using penicillin a long time ago because the staphylococci were resistant. Now he was finding organisms turning up in herds which were resistant to streptomycin and sensitive to pencillin. A penicillin holiday was a good idea.

With regard to subclinical mastitis, when samples were taken, he asked farmers in which quarters they had recently seen clots and often quarters were mentioned which had shown clots on one occasion only. He usually found subclinical mastitis in those quarters. He did not think so-called subclinical mastitis always remained subclinical. The farmer might say he was finding clots on the filter pad and was unable to trace the mastitis to any particular cow.

Mr. Davidson said that he agreed with all that Dr. Blackburn had said.

Mr. O. Swarbrick (Arundel) said that Mr. Wilson had already pointed out the clinically impossible task of diagnosing the causal organism of a particular case; he believed himself that it was equally impossible to assess the degree of mammary damage which had already occurred and was continually amazed at the cases where he gave a poor prognosis which recovered rapidly, and those where he gave a good prognosis which nonetheless proved clinically obstinate. The degree of pathological change within the udder was obviously at least as important in therapy as the causal organism. The difficulty of obtaining an adequate dose of medicament where required had also been mentioned, and as Ullberg and his co-workers pointed out, the problem was the more difficult in diseased udders, especially where the milk ducts were blocked with inflammatory debris.

There was also the difficulty of ensuring treatment for a sufficiently long period, and in that connexion, he considered that therapy was not persevered with sufficiently long after clinical symptoms had subsided. Medical practice, with a condition as severe as most clinical mastitis cases, would be to continue treatment for at least a week after a good clinical recovery in the first day or so. The farming community however would not accept the necessity for that, and if one left even one or two doses on the farm for follow-up treatment after personally administered therapy had achieved an apparent clinical cure, those dispensed doses were likely to be hoarded and used on the next case before attention was requested! He felt that the inadequate duration of treatment was a potent source of chronic cases. For all those reasons, to which could now be added the likelihood of selecting an ineffective antibiotic, the treatment of frank mastitis had become a major clinical hazard.

In spite of the work of Ullberg and others, he still felt that the use of ¼ g. of streptomycin, or 300,000 units of penicillin or the other small doses of antibiotic placed into the bottom of the teat in a small volume of a vehicle not readily miscible with an aqueous fluid and then to expect an adequate level of medicament throughout the quarter of, say, a Friesian cow which could hold almost a gallon of fluid, was clinical nonsense. Consequently, he used aqueous solutions of medicament in large volumes. He was convinced that produced a better clinical effect, and it was a technique not readily available to the owner; consequently, the clinician got the credit for the successful treatment and not the tube of Somebody's antibiotic. He found his actual dosage of drug and volume of vehicle both continued to rise, and currently, he used 1 g. of oxytetracycline* in about 500 ml. of sterile normal saline; that was prepared by squirting 2 tubes of intramammary oxytetracycline into the saline and running the solution into the quarter with a sterile flutter valve and teat siphon. If he wished to use corticoids, 25 mg. of prednisolone were added to the solution before infusion. The treatment he repeated daily to effect or until it was obvious that he had to change his antibiotic. He left tubes of oxytetracycline for follow-up and a tube of chlortetracycline† to finish as it was in an oil base, and he hoped thereby to prolong its presence within the quarter. Severe and febrile cases usually received intramuscular tetracycline therapy in addition; he believed that if that was undertaken, large doses were necessary to make it worthwhile: at least 1 g. While that appeared a clinically sensible thing to do, he was less sure of its value and it was expensive. Although Mr. Wilson condemned the use of deep intrammary injection, they were useful in cases where a residual and circumscribed area of fibrosis or induration could be felt in the quarter; direct injection within the mass usually produced gratifying results. Doses used were about ½ g. daily of tetracycline.

Like Mr. Wilson, he found the exhibition of various ancillary aids of little help. Trypsin infusion and the emptying of the quarter with pituitrin had been valueless in his hands. He retained an open mind on corticoids but was not impressed with results of giving them either parentrally or locally. The use of a potent diuretic on cases complicated with severe oedema would appear a reasonable thing to do, but large doses of Messrs. Ciba's Vetidrex did not seem of material assistance.

The treatment of established chronic cases was useless and he always advised their destruction on the dual ground of being a menace to other cattle and an economically poor proposition owing to reduced production. That advice was not very acceptable to the owners, but it seemed reasonable to remove from the herd one potent source of continuing infection.

Professor D. L. Hughes (University of Liverpool) said that everyone would agree that if it had not been for the contributions of Weybridge and Compton over the last 20 years, less would be known about the problem than was known now. The symposium had been a good illustration of that.

He had been interested in Dr. Derbyshire's discussion on the problems of immunisation; Dr. Derbyshire still seemed to remain an optimist in the matter. The vast majority of staphylococcal infections were fairly mild affairs, the kind of infection which those who remembered *Streptococcus agalactiae* infections had the greatest difficulty in distinguishing clinically. That being so, in the vaccination tests, the challenges, given to goats or cows were always violent reactions, nad there seemed to be a long way to go to produce a vaccination procedure which would entirely

---

* Terramycin.

† Aureomycin.

suppress the mild chronic reaction which constituted the bulk of the problem.

He agreed wholeheartedly with Mr. Wilson in his criticism that many of the survey figures were misleading in the sense that they were underestimates. The "Wastage and Disease Survey" figure of 10.5 per cent. given was far too low. He was never happy about surveys which took place on one day only because a very distorted picture could be produced by that technique. Seasonal incidence entered into it very much and a one-day survey in the middle of May would give a different picture from a one-day survey in the middle of November. It would not however influence the staphylococcal picture very much because the staphylococcal infections did not appear to be particularly governed by season.

In passing, he asked Mr. Wilson whether there were any figures with regard to the nutritive value of leucocytes in milk!

He had been interested to hear the slight disagreement on whether staphylococcal distributions within the herd could be strictly compared with those of *Streptococcus agalactiae*. Broadly speaking, he thought there was a broad similarity but the staphylococcal picture was more difficult. He accepted the statement that there could be multiplication of staphylococci on the skin but Davidson's statement that at least 2 of his strains were introduced into his herd by men could not be ignored. That had never been a problem with *Str. agalactiae*, but it seems that the cowmen could be a cause of breakdown in herds free of staphylococci. He agreed with Edwards that infections of staphylococci might open the way to other infections. In a survey undertaken by the speaker (Hughes, 1960), infections in terms of mixed infection were analysed and staphylococci were the organisms which were the most frequently accompanied by other organisms.

Dr. Derbyshire referred to Professor Hughes's statement that most staphylococcal mastitis infections were of a mild nature. It should not be forgotten that severe clinical cases of mastitis had occurred in certain herds and an efficient vaccine would be of value in such herds. Looking more closely at the situation regarding the mild infections which it was not possible at the moment to control, Professor Hughes had said that the challenge procedure used in goats was a severe one. He agreed, but felt that if a vaccine could be developed which would protect against a severe challenge infection, such a vaccine would be protective against a mild low-grade infection if antibody could pass from the blood into the milk.

Two approaches were possible. One was the approach of local immunisation; he had mentioned the drawback of irritation of the udder tissue, but that was not insurmountable. If a protective antigen could be identified, it might easily be prepared in a relatively pure, non-irritant state and injected into the teat canal of the dry cow as she approached calving, with some hope of giving a better degree of local protection of the udder.

Another possible approach might be, if there was an efficient vaccine, to vaccinate the cow systematically and give some non-specific stimulus to the udder, which would result in the release of antibodies into the milk for a period.

Mr. Wilson, in reply, said that a case had been known of human beings having introduced infection into a herd that had been cleared. The herd had been freed of *Streptococcus agalactiae* but was found to be re-infected. It was discovered that the new infection was a different type from the original infection in the herd but identical with that found in the throat of one of the milkers. This milker had milked an infected cow at his own home and this cow was the primary source of the infection.

Mr. J. B. White (Salisbury) said that he had been struck, in Mr. Davidson's paper, with the long period of time that might elapse between the introduction of the staphylococcus and the establishment of clinical disease. Did one have gradually to build up the level of infection? Did a certain challenge of infection have to be reached before clinical infection could be established? It would seem to have a bearing on the question of milking technique. There was no doubt in the minds of practitioners that milking technique was the rock of mastitis control; presumably, if there was teat erosion, a lower level of infection could establish clinical disease as against the higher level necessary with a sound udder. It was very clear that frequently, if a dairyman who had been milking for 20 years with a 50/50 phase pulsation rate was put on a 3:1 phase pulsation rate, he was in trouble because he could not adjust himself to the quicker milking of his cows. Those points were the principal ones that had to be concentrated on in chronic mastitis control. The points about milkers' hands and udder cloths were very important in the infected herd but they were complementary to the primary one of milking technique.

No one had mentioned—and he was not sure it was applicable to the problem—the question of cold sterilisation. It was applicable with regard to the keeping qualities of milk but he was not sure that there was such a clear picture with regard to mastitis control.

He asked Mr. Wilson whether he considered the steaming up of cows before calving as provocative of acute staphylococcal mastitis at calving time, and whether he had figures as to the amount of antibiotic recoverable in milk or actually in the milk as a result of parenteral medications as with intramuscular injections, which was the choice of route by which acute cases were treated. He was not sure how it passed the blood/milk barrier. Was there much benefit from the intravenous injection of those drugs as distinct from intramuscular injection.

Mr. Davidson, in reply, said that he did not know the reason why there was the long gap between the introduction of a particular staphylococcus and the production of mastitis. Mr. White's explanation might apply in some cases; it did not apply in all cases. In some cases, numbers had built up quite quickly on udder and teat skin and there had still been a long gap before mastitis cases occurred. He could offer no sound reason for it.

With regard to the correct use of the milking machine in connexion with the control of staphylococcal mastitis, those two factors of general management, especially the use of the milking machine and of good hygiene, were complementary but he would put them on a par with each other; in the recent past, good hygiene had been neglected and it had an important part to play—as important a part as the correct use of the milking machine and the correct management of the cows in general.

Mr. Wilson said that there was evidence in a number of herds that, with excessive steaming up, there had been quite a heavy incidence of mastitis either just before calving or at calving. Whether it was due to excessive protein and was a form of protein poisoning, he did not know; what he believed to be more likely was overstocking caused traumatic damage to the udder. Certainly, overstocking seemed to be very dangerous to cows' udders. There had been 2 serious outbreaks which had got better when steaming-up with resulting overstocking was stopped.

Dr. Edwards said that penicillin was too rapidly eliminated to use by any other route than direct injection to the udder. Sometimes, injection straight into the mammary tissue was effective though many people considered that to be a dangerous route. Where there was severe induration as in summer mastitis it was no use injecting it in the ordinary way into the teat canal, because there was no penetration at all. If, however, one got an early case within the first 24 hours, he had noticed quite a few recoveries after injection into the mammary tissues of 2 doses of 100,000 units of penicillin.

Mr. A. I. Wright (Macclesfield) said that probably the greatest factor in the control and suppression of this disease which was so frequently being met now, was the milking hygiene and technique. He was surprised that Dr. Edwards had emphasised the need for stripping. He was not denying that Dr. Edwards might have evidence that stripping was necessary but many of those in practice felt that under-milking rather than over-milking was a greater help in controlling the disease, particularly since the advent of the moulded liner and its "gartering" effects on the teat when left on too long.

In herds where the attendants were not very good or experienced they were emphasising under-milking rather

than leaving the cups on too long. He was surprised that stripping was as necessary as had been inferred, and was sure that many, in trying to strip, would do more damage and cause damage to the teat and increase the incidence of staphylococcal mastitis.

Dr. Edwards, in reply to Mr. Wright, hoped he had not given the impression that machine stripping was necessary in all cows because that would be a very bad practice to adopt but some cows had to be machine stripped, otherwise they were likely to develop mastitis; these were cows with very large teats. The machine was quite incapable of removing all the milk because it was found that the teat cups only seemed to cover about one half of the teat surface and under those conditions, no mechanical method seemed to be efficient. The number of cows that had to be machine stripped was small and a good milker was worth a lot to the farmer because he knew how to manage those difficult cows.

Mr. G. V. Short (Wilmslow) said that he had understood Dr. Edwards to say that there was evidence that staphylococcal survival outside the udder was no more than 9 days. Some fairly extensive Swiss work showed that mastitis streptococci, anyway, survived up to 3 weeks, particularly in soiled bedding (Grossenbacher, E., *Swiss At. Rpt.* (1951)).

Dr. Edwards, in reply to Colonel Short, said that there had been conflicting views. The reason why particular attention was paid to studies on the survival of staphylococci was because of its importance with regard to the eventual eradication of infection; if the organism could persist for a long period outside the udder and in many different sites, the question of eradication became extremely difficult.

The Chairman suggested that there might be a misunderstanding in that Dr. Edwards was talking about putting culture on teats and Mr. Davidson might be talking about natural infection.

Mr. Davidson said that he was referring to naturally occurring infections of the skin. It was rather different from what Dr. Edwards was doing. If culture was painted on the teat skin, in most cases infection was not established and the staphylococci died out quickly, but there were naturally occurring cases of skin infection in which infection persisted on the cow's udders and teat skin for very long periods, sometimes right through the dry period. He had known a case of a dry period infection during which for many months the inside of the cow's udder was completely free from infection; it was an extramammary infection on the udder surface.

A point of interest had arisen from some medical work. The suggestion was that once the staphylococci had left lesions and were present on inanimate matter, although they might survive for long periods, they rapidly lost their virulence and were less likely to cause disease than staphylococci that had newly come from a lesion.

Dr. A. Foggie (Animal Diseases Research Association, Edinburgh) asked Dr. Derbyshire if he had any idea how long the immunity lasted? Could he give any idea of the immunological status of cows that had mild infection? Such a cow might have a high level of staphylococcal antitoxin in the blood. He had done an experiment where a staphylococcal vaccine with added toxoid was inoculated into half of a group of lambs, the remaining lambs being unvaccinated controls. There was a highly significant difference in the number of tick pyaemia cases developing in the two groups but the greater number of cases occurred in the vaccinated group. A similar anomaly was known to occur in the treatment of boils in humans with homologous staphylococcal vaccines. These occasionally produce a cure and occasionally made the condition much more severe.

In his examination for the carriage of staphylococci Mr. Davidson did not give any indication of the number of organisms found at the different sites. In the examination of staphylococcal carriage at different sites in ewes it had been found that occasionally there had been extremely heavy contamination of the nose and vagina. He wondered if Mr. Davidson found similar heavy infections in cows.

Dr. Derbyshire, replying on the question of duration of immunity, said that he had not done specific experiments, but of some relevance were observations on goats which were challenged shortly after vaccination. These became infected but did not develop severe mastitis, and carried the infection throughout lactation with no breakdown.

With regard to the immune status of cows with mild mastitis, such animals had an appreciable level of alpha anti-toxin, about 4 to 8 units, which he would not regard, from his experimental work, as sufficient immunity to give them certain protection against severe mastitis.

Mr. Davidson said that the numbers of staphylococci were not given in the paper, but these had been published. In general, he found that the numbers of staphylococci on the udder and teat skin were the highest. Occasionally, high numbers were found in the perineal region or in the vagina, the two usually occurring together. Large numbers in the perineal region were associated with large numbers in the vagina. Other sites gave small numbers, the nose probably least of all.

Miss O. Uvarov (Greenford) said that she had thoroughly enjoyed the symposium and was sorry that the time was so short and the discussion could not be extended. Many points could be raised.

With regard to resistance of staphylococci to antibiotics, at their laboratories 284 strains of staphylococci had been tested for sensitivity to penicillin, streptomycin and novobiocin. Methods used were the plate disc method and the tube dilution method. There was found to be a certain amount of variation with some of the organisms. The figures supported Mr. Wilson's findings that among the strains, 70 per cent. were resistant to penicillin. The figure for streptomycin was about 21 per cent. With regard to novobiocin, both by disc and tube dilution methods, the figures were lower. By tube dilution, only 0.9 per cent. of organisms were resistant to that antibiotic.

The question of testing for sensitivity was most important. On occasions, some people were not very satisfied with the disc method. With regard to the statement that practitioners might be tempted to ring the changes in antibiotics, it was a question of knowing much more about the existing antibiotics and combinations of antibiotics rather than using all the different permutations and hoping to get new antibiotics. More specific information was needed on the ones that were available in relation to the existing pattern of disease.

Miss Uvarov had used penicillin by the intramuscular route and antibiotic assays of blood and milk had been done. This confirmed the earlier work of Dr. Edwards to the extent that the use of 5 million units of crystalline penicillin injected intramuscularly, produced a high initial concentration of pencillin in the blood; within a matter of half an hour after injection the levels were on the average 6 to 12 units per ml. As in previous reports it was shown that from injection of crystalline pencillin, it was out within 8 to 10 hours after each reinjection. The penicillin levels in milk were low at about one hour after injection, the maximum level found was approximately between 4 to 6 hours. There was some variation in pencillin levels in milk of different quarters, as well as some variation from subsequent reinjections of penicillin. In answer to Mr. White's question the maximum concentration of penicillin in milk from the use of 5 million units of crystalline penicillin was 0.19 units per ml.

As far as hygienic control was concerned, she had good news for Mr. Davidson: his method really worked under practical conditions. She had used the system described of circulating hot water through the clusters and the milk tube, and in the last 9 months, there had been only 3 cases of staphylococcal mastitis in their experimental herd. That was extraordinary because these cows were used frequently for evaluation of different substances in the udder.

She wondered to what extent sub-optimal treatment was found in the field and perpetuated the disease? The question of doses for intramammary formulations required further investigation. Miss Uvarov had found that some antibiotics were absorbed from the udder into the circulating system. The question of retreatment was important particularly when the whole herd was being treated.

The Chairman had started the session by saying how

(Concluded at foot of adjoining column)

Clinical Notes

Dislocation of the Fetlock in a Cow

A. R. Hopkins

Tiverton

CERTAIN dislocations in cattle, whilst not common, have been observed frequently enough to have been recorded on more than one occasion. Notable among these are dislocations of the shoulder, hip and patella. The case recorded below is one of dislocation of the fetlock.

Subject. The subject was an Ayrshire cow which came in on the afternoon of September 18th, 1960, severely lame in the left foreleg—so much so that she could scarcely take any weight on the limb, and once recumbent had the greatest difficulty in rising.

Diagnosis. On examination, the diagnosis was obvious since very little swelling had occurred at the fetlock joint and the ends of both metacarpus and os suffraginis were easily palpated. The luxation was immediately lateral, the upper ends of the os suffraginis having moved outwards by the width of half the upper articular surface of each. (The proximal articular surface of each os suffraginis is divided by a sagittal groove into two areas which articulate with similar surfaces on the distal end of the metacarpus.)

Treatment. It was not possible to perform reduction until 4 days later, but even after this time no further swelling had occurred. The cow was given chloral hydrate intravenously in the standing position until cast; she was then placed in lateral recumbency with the affected limb uppermost. A calving snare was attached to the pastern so that its noose tightened on the outer side. Traction was applied in line with the limb and slightly axial (*i.e.* towards the ground), the limb being supported approximately parallel to the ground. No counter traction was needed and reduction was accompanied by a satisfactory click as the joint was restored.

A strong plaster cast was applied which survived for 20 days and was then removed.

Results. Possibly the cast was unnecessary since the fetlock joint is well endowed with tendinous and ligamentous support. However, considerable damage must have been incurred by these ligaments for luxation to have occurred. The cow walked soundly almost immediately after the reduction of the luxation. Slight enlargement of the fetlock joint has persisted, but the cow is otherwise sound and has the full range of normal movement in this joint.

It is quite easy to imagine how this injury might occur, though a considerable force must be needed to effect it.

Metaldehyde Poisoning in the Dog

C. B. Woodham

IN view of the high mortality rate encountered from this poison, the following case record may be of interest.

Date: May 8th, 1961.

Subject. Corgi × terrier bitch, aged one year, in good bodily condition and with no previous history of ill-health, submitted on May 8th, 1961.

History. At about 11 a.m. the bitch was seen to lick slug dressing containing metaldehyde which had been applied to a lawn. Nothing untoward occurred until 1 p.m. when vomiting and convulsions were observed.

Examination. Admitted at 1.25 p.m. the subject was in a state of opisthotonous rigidity with continuous superimposed muscle tremors. Both pupils were evenly dilated, profuse salivation was observed, with heart and respiratory rates markedly increased and temperature elevated to 102.5° F.

Treatment. Pentobarbitone sodium gr. 1 in 1 ml. diluent administered intravenously rapidly suppressed more spectacular symptoms, but at this stage it was thought unwise to proceed to an anaesthetic depth. Pethidine hydrochloride 25 mg. was administered intramuscularly and repeated at 6 p.m. and 10 p.m., by which time the convulsions had completely subsided, though muscular twitching was still evident. The subject was kept in darkened quiet surroundings during treatment and handled as little as possible. At 8 a.m on May 9th, general physical examination appeared to indicate complete recovery, and at July 2nd no secondary effects have been reported.

Symposium on Staphylococcal Mastitis.—*Concluded.*

much more research was needed. She was doing work on antibiotics and it appears that the original ideas on the treatment with antibiotics had been over-simplified and more research was needed in clinical pathology of this disease. When people thought that, by eradicating one disease, they might be short of work, she could not help thinking of the amount of work that had to be done on bovine mastitis. This appeared to be so vast that she did not think they would ever be out of work.

The Chairman thanked Miss Uvarov for her interesting and useful comments and for bringing the meeting to an end on a note of unquestionable enthusiasm. He thanked the authors of the papers and those who had taken part in the discussion.

Mr. S. L. Hignett said that those present were very impressed with the way in which the Chairman had conducted the business of the meeting. He had set a very high standard of chairmanship and extracted the maximum amount of information, not only from the speakers but from those who had taken part in the discussion.

Infectious Sinusitis of Pheasants and Partridges

BY

I. F. KEYMER

Central Veterinary Laboratory, Weybridge, Surrey

SUMMARY.—1. The natural infection of pheasants (Phasianus colchicus), *partridges* (Perdix perdix) *and red-legged partridges* (Alectoris rufa) *with infectious sinusitis, is described.*

2. Diagnosis of the disease in pheasants was based upon clinical signs, serological examinations, post-mortem *lesions, microscopical examination of sinus exudate, culture results, results of embryo inoculations and transmission experiments using susceptible turkeys, domestic fowls, a pheasant and a partridge.*

3. It is shown that the disease is associated with pleuropneumonia-like organisms (P.P.L.O.).

CONSIDERABLE confusion exists regarding the incidence and cause of respiratory conditions in game birds and there are only a few reports of infectious sinusitis, associated with P.P.L.O. *i.e.* Mycoplasmatales.

Pheasants (*Phasianus colchicus*) were artificially infected with *Mycoplasma gallinarum* by Van Roekel and Olesiuk (1953), and Osborn and Pomeroy (1958) briefly described a natural outbreak of the disease in America in pheasant poults which were believed to have been infected by turkeys. Jerstad and Hamilton (1948), however, failed to infect pheasants by penning them with turkeys affected with the acute form of the disease. The only published record of sinusitis in pheasants in Great Britain is by Keymer (1958).

Gianforte, Jungherr and Jacobs (1955) in America reported the isolation of P.P.L.O. from a "Connecticut partridge" affected with "infectious turkey sinusitis" the species of partridge not being stated. Natural infection of the American chukar partridge (*Alectoris graeca*) has been described by Wichmann (1957) but there are no reports of the disease in either of the British species *viz*: the common partridge (*Perdix perdix*) or the red-legged partridge (*Alectoris rufa*).

There is some evidence that sinusitis in pheasants and partridges is becoming more common in England. Middleton (1960) of the I.C.I. Game Research Institute, stated that before 1959 the disease was seldom seen, although Keymer (1958) at Weybridge recorded cases during the summers of 1955 and 1956. During the course of a survey of diseases of game and wild birds, no further outbreaks were encountered in 1957 or 1958, when a total of 214 of these species were examined, but in 1959, 14 outbreaks were seen in 12 different English counties, 10 of them in pheasants, 3 in red-legged partridges and one in common partridges. That year a total of 111 pheasants, 31 partridges and 5 red-legged partridges were examined. During 1960 when 246 pheasants, 54 partridges and 12 red-legged partridges were examined, 6 outbreaks were seen in pheasants and 3 in common partridges; 6 English counties being involved.

Differential Diagnosis

For many years gamekeepers in Great Britain have occasionally encountered respiratory diseases in game birds, especially pheasants, and terms such as "roup," "coryza," "colds," "sore head," "ophthalmia," and "diphtheria" have been used to describe the clinical signs. Undoubtedly these terms refer to more than one specific disease, although superficially the clinical signs may be similar. It is essential therefore to pay special attention to differential diagnosis when encountering respiratory conditions, and to realise that more than one disease may be involved in a single outbreak.

The most prevalent respiratory disease in game birds is "gapes" or syngamiasis, due to infestation with *Syngamus trachea,* but other specific diseases are occasionally encountered.

Pox affecting pheasants has been described in this country by Dobson (1937) and the clinical signs and *post-mortem* lesions closely resembled those seen in sinusitis described in this paper. Newcastle disease has also been recorded occasionally in pheasants and partridges (Keymer, 1958), but has not been described in detail. One suspected outbreak in pheasants, associated with sinusitis and keratitis, however, was investigated with Locke (1959), following a provisional diagnosis of Newcastle disease based on positive reactions to the haemagglutination inhibition (H.I.) test. Virus isolation was attempted but without success. Pheasants are also susceptible to infectious laryngotracheitis (Hofstad, 1959) and ornithosis (Meyer, 1959), but both diseases are rare and have not been recorded in pheasants in Great Britain. Infectious bronchitis can probably be ignored, as it is apparently confined to the domestic fowl. There is evidence that virus infections have a synergistic effect in *Mycoplasma* infections, although Adler (1960) stated that uncomplicated *Mycoplasma* infections do occur in the domestic fowl.

Two bacterial causes of respiratory disease in pheasants are *Haemophilus gallinarum* (Delaplane, Erwin & Stuart, 1934) and *Pasteurella aviseptica.* The former disease appears to have been reported only once, and on the basis of the work of McKay and Taylor (1954) it is even possible that this organism was in fact a P.P.L.O. Pasteurellosis is uncommon in pheasants (Keymer, 1958) but the disease has been diagnosed in this country in partridges by Jennings (1954).

Although at this laboratory routine bacteriological examination is carried out, septicaemic infections have never been diagnosed in outbreaks of sinusitis. When mucus from the sinuses has been cultured, *Escherichia coli* organisms have been isolated many times and also occasionally *Pseudomonas pyocyaneus* and *Proteus.* It is unlikely, however, that these bacteria were the primary cause of the sinusitis.

Aspergillosis is quite well known in pheasants, but this disease normally affects only the lower part of the respiratory tract.

Nutritional roup caused by vitamin A deficiency is occasionally seen in artificially reared game birds and the *post-mortem* lesions in a few specimens suggested that it may have played a part in the outbreak of sinusitis to be described later in this paper.

Infectious Sinusitis in Pheasants

The condition appears to be primarily a disease of young birds. Artificially reared poults between 2 and 8 weeks of age are mainly affected, but clinical signs have also been seen occasionally in adults living in the wild state. In several outbreaks, the disease has not become apparent in poults until after they have been put to covert. In most cases it was known that the poults had been brooded by apparently healthy domestic fowls, but on no occasion was there a history of contact with turkeys. The disease in pheasants has been seen mainly in June, July and August. Heavy losses up to as much as 90 per cent. have been reported. The disease appears to be contagious, although in captive birds it has not spread quickly from one pen to another and at times has remained confined to one pen of poults only.

Clinical signs. Excessive blinking and occasional scratching of the eyes and nostrils are usually the first signs. Head shaking occurs and pipping sounds are made as the affected birds attempt to dislodge mucus from the nostrils. Dejection and drowsiness follow within a day or two. If a bird is left undisturbed, the head is withdrawn into the shoulders, the eyes are closed and it appears to sleep. Obvious photophobia is present and swelling of the eyelids (usually bilateral) occurs within a few days, associated with a watery ocular discharge (Fig. 1). After

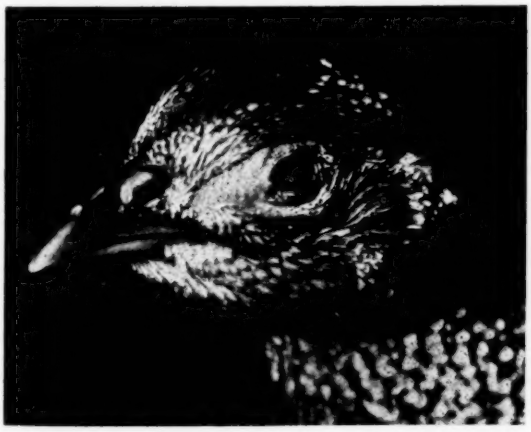


FIG. 1.—Pheasant poult naturally infected with infectious sinusitis in the early stages of the disease, showing swelling of the eyelids, slight corneal opacity and swollen infra orbital sinus.

about 5 or 6 days, adhesion of the eyelids takes place due to the formation of a sticky mucoid ocular discharge and small whitish flecks of purulent material may develop in the corners of the eyes. Conjunctivitis has not been an obvious feature in the specimens examined, although keratitis, resulting in corneal opacities and ulceration involving up to a quarter of the surface of the cornea have been noticed in about 25 per cent. of the cases. It is at this stage of the disease that death most commonly occurs, probably from starvation caused by blindness, especially in birds which have been released into coverts. When the poults are confined to runs or cages, so that they can find their food, death may not occur and the clinical signs in some birds become even more severe before gradual recovery takes place. In severely affected poults, lumps of caseous material may form beneath the lower eyelid (Fig. 2) and

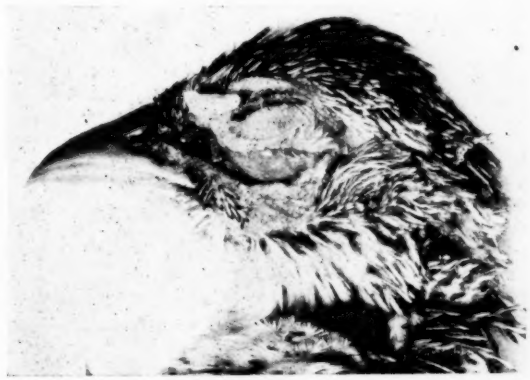


FIG. 2.—Naturally infected pheasant poult which had shown clinical signs for approximately 3 weeks. The infra orbital sinus has been opened to show the presence of a small quantity of clear viscous mucus. The white lump of caseous material was situated between the lower eyelid and the eye and the eyelids are slightly swollen.

bilateral distension of the infra orbital sinuses may become obvious, together with a slight mucous discharge from the nostrils. If birds affected in this way are disturbed, respiratory distress develops, manifested by gasping and gaping for air.

Post-mortem *lesions.* In birds which have died, the entire alimentary tract is usually devoid of food and no lesions are present in the abdominal viscera or the lower part of the respiratory tract. A constant finding, however, is an excessive amount of clear or slightly opaque viscous mucus in the infra orbital sinuses. In a few advanced cases, whitish necrotic plaques firmly adherent to the mucous membrane and varying in size from 1 to 2 mm. × 1 to 5 mm., have been seen in the mouth. These lesions are usually on the dorsal aspect of the pharynx in the region of the nasal cleft and have sometimes been seen on the external surface of the larynx. On one occasion, minute pin-point lesions present on the dorsal aspect of the pharynx extended for an inch down the oesophageal mucosa, the lesions rather resembling those of vitamin A deficiency in the domestic fowl.

Infectious Sinusitis in Partridges

Although comparatively few affected common partridges have been examined, the disease appears to be similar to that seen in pheasants and young birds up to 11 weeks of age are mainly affected. Unlike the disease in pheasants, swelling of the face due to the formation of necrotic material in the infra orbital sinuses has been seen. In this species, the disease has not been confined to the summer months, having been encountered in late February, March, August and September.

In red-legged partridges the disease is similar but has only been seen in wild adults during August and December.

Investigation of an outbreak of Infectious Sinusitis in Pheasants

History. One typical outbreak, which occurred on an estate in Hampshire during July, 1960, was selected for detailed investigation. The poults were reared in pens on "clean" ground, being brooded by apparently healthy domestic fowls. At 5 to 6 weeks of age, 500 were put to covert, with the fowls confined to coops and the poults free to roam in the wood. Clinical signs were first noticed approximately 10 days after release, whilst the pheasants were still in contact with the hens. It was estimated that over 450 birds became infected, but the foster parents remained healthy. Five days after the commencement of the outbreak 20 deaths had occurred and it was then that typically affected live specimens and carcases were submitted for examination. The total loss in this batch eventually reached 100. In another covert, where 300 poults were released, however, only 20 became infected and 6 died. The owner attributed the comparative mildness of the disease in the second group of birds to the fact that they were given cod liver oil mixed with the rearing pellets soon after clinical signs were first noticed.

In the autumn an adult cock pheasant was seen on the estate showing typical clinical signs of sinusitis, and the following summer of 1961 pheasant poults again contracted the disease, becoming infected in the wood where this bird was seen and also in another covert several miles away. The disease had not been encountered before on these parts of the estate and in the woods where birds had sinusitis the previous year, no affected poults were seen.

During the 1961 outbreak, all the domestic fowls in contact with 2 groups of infected poults and some of those in a covert with healthy poults were bled and their sera subjected to the P.P.L.O.-H.I. test. A high percentage of reactors was found in each group of fowls.

Diagnosis

(*a*) *Serological examination.* Nine live poults in various stages of the infection were received for examination. All, however, had shown clinical signs for at least a week. The birds were bled and their serum subjected to the H.I. tests for Newcastle disease and for *Mycoplasma* infection. The results were all negative for the former test, but all positive for *Mycoplasma* using a P.P.L.O.-H.I. antigen prepared from the D strain of P.P.L.O. isolated from turkeys. The method used was that described by Fahey and Crawley (1954). The sera to be tested were diluted by two-fold dilutions from 1:5 to 1:40, a titre of 1:5 or over being regarded as positive. Titres of 1:40 or more were present in all the birds at the first test, but subsequent tests showed a fall of titre as clinical signs subsided and the sera became negative within a period of one or two months, whereas naturally infected domestic fowls remain serologically positive for many months.

(*b*) *Microscopical Examination of Sinus Exudate.* Sinus material was taken from pheasants which had shown clinical signs for about a week and thick smears of the mucus were fixed in methyl alcohol and stained by Giemsa's method; scrapings of the conjunctiva were also made. Examination revealed very little bacterial contamination but a few extracellular organisms were seen which resembled pathogenic P.P.L.O. (Chu, 1958) at both sites. Edward (1954), however, stated that P.P.L.O. are too small and pleomorphic to be easily distinguished from other types of granules in stained smears and therefore too much importance must not be attached to this finding.

(*c*) *Culture results.* In addition to routine bacteriological examination for the isolation of the usual aerobic pathogens referred to earlier, attempts were made to cultivate *Mycoplasma* from sinus mucus, using special media. Mucus taken from the sinuses and trachea of two affected pheasants was inoculated on to Edward's agar and P.P.L.O. were isolated from both sites. Colonies appeared at approximately 24 hours, and morphologically resembled the non-pathogenic type of P.P.L.O. described by Chu and Newnham (1959). McDiarmid (1960), however, who also investigated a similar outbreak of sinusitis in pheasants about the same time, succeeded in growing P.P.L.O. on brucella agar*, which he believed to be of the pathogenic type.

(*d*) *Results of Embryo inoculations.* One dozen 9-day-old embryonated eggs were inoculated by the allantoic route using an approximately 10 per cent. suspension of sinus mucus in normal saline, together with penicillin and streptomycin. All of these eggs hatched.

A dozen 6-day-old embryonated eggs were also inoculated by the yolk sac route with the same inoculum, but without streptomycin. An irregular pattern of mortality occurred, 2 embryos died on the 4th day after inoculation, 1 on the 7th and 2 on the 10th, whilst 3 hatched. On the 10th day, however, 4 were killed and the chorio-allantoic fluid harvested and used for a second passage using the same method as before. Four days after inoculation 11 died and the remaining embryo was killed on the seventh day. A third passage was then carried out as before, when 7 died on the third day, 3 on the 7th day, one on the 8th and one on the 14th day after inoculation.

Most of the embryos which died showed cutaneous haemorrhages but no other obvious macroscopic lesions.

* Prepared by Albimi Laboratories.

Attempts were made to culture *Mycoplasma* from most of the embryos, using Edward's agar with and without the addition of penicillin and thallium acetate. Routine bacteriological examination was also carried out to determine the degree of contamination. *Mycoplasma* were isolated from several embryos and in some cases these were clearly of the saprophytic strain, whilst others morphologically resembled the pathogenic type described by Chu and Newnham (1959).

(*e*) ***Results of Transmission Experiments.*** In view of the close resemblance of the clinical signs and *post-mortem* lesions to pheasant pox, it was obviously essential to eliminate the possibility of this infection. As Dobson (1937) was able to infect domestic fowls and pigeons with pheasant pox, an inoculum consisting of a crude 20 per cent. suspension of sinus mucus from 2 typically affected pheasants was prepared. The skin on the breast of two healthy pigeons was scarified, also the comb and wattles of 3 young fowls, the conjunctiva and cornea of 2 others and the buccal mucosa of 2 more. Serum taken before the experiment from all of these birds gave negative results when subjected to the P.P.L.O.-H.I. test. No visible skin lesions or clinical signs developed in any of the birds, but when the sera of the fowls (except those scarified in the buccal cavity) were subsequently tested for P.P.L.O. by the H.I. test, all reacted. The highest titres occurred in the birds which were scarified intra-ocularly, reaching at least 1 : 80, and their sera remained positive for over a year. In none of the birds was a negative result obtained until after 4 months.

In addition to the above experiments, the sinuses of 3 two-week-old chicks, 2 two-week-old turkey poults and 2 three-month-old turkeys whose sera were negative to the P.P.L.O.-H.I. test were injected with 0.5 ml. of a 20 per cent. suspension of sinus mucus from infected pheasants.

Two of the chicks developed a slight watery ocular and nasal discharge 3 weeks later, which in 1 bird disappeared within a week. In the other, however, the injected sinus became swollen and clinical signs did not subside for 2 weeks. Using the P.P.L.O.-H.I. test, titres of 1:20 were present 13 days after injection. Titres of at least 1:80 soon developed and significant titres were still present after 1 year.

In the young turkey poults, the reaction was more marked. Ocular and nasal discharge developed within 2 days and severe clinical signs of sinusitis soon developed. Two weeks after injection one of the poults was killed and photographed (Fig. 3). The serum of this poult, however, did not develop an H.I. titre, although that of the other poult showed a titre of 1:10 at 2 weeks and was 1:40 when the bird was killed, 6 weeks after injection. *Post-mortem* examination of the latter revealed extensive air sac lesions with the formation of necrotic material.

The 2 large turkeys developed sinusitis at 14 days and 19 days after injection. One was killed on the 14th day when its serum was still negative to the H.I. test and serum from the other bird was tested at approximately weekly intervals. A positive reaction to the H.I. test was not obtained until 8 weeks after injection. Clinical signs subsided after 16 weeks and the serum became negative after 22 weeks. At no time, however, did the titre exceed 1:40 and severe sinusitis did not develop. When the sinusitis was most noticeable, some sinus mucus was withdrawn with a syringe and a smear was prepared and stained by Giemsa's method. This showed numerous clumps of extra and intracellular cocci and coccobacilli resembling P.P.L.O.

FIG. 3.—Turkey poult showing the presence of a large quantity of clear viscous mucus in the right infra orbital sinus, 2 weeks after injection with 0.5 ml. of a 20 per cent. suspension of sinus mucus from a pheasant naturally infected with infectious sinusitis.

In addition to these pathogenicity tests, 2 two-week-old turkey poults and one adult turkey, were injected into the sinuses with sinus mucus from the artificially infected turkeys referred to above. A healthy turkey was also kept in the same pen with the adult bird. All of the injected birds developed sinusitis within 6 to 8 days and the other bird after 5 weeks, although it became positive to the H.I. test after three weeks having a titre of 1:20. Before injection, the sera of all the turkeys were negative to the H.I. test, titres developing within 2 to 3 weeks. One of the young poults and the adult bird were killed after 5 and 6 weeks respectively. Severe sinusitis and a titre of more than 1:80 developed in the other young bird, the titre still being high after a year.

During the course of the above experiments turkeys and fowls kept as controls remained normal.

One adult pheasant and one adult partridge were similarly injected with sinus mucus from an artificially infected turkey. The pheasant developed sinusitis after 4 days and the partridge after 7, whilst clinical signs eventually became severe in both birds. The partridge recovered after 6 weeks and the pheasant after 18 weeks. A titre of 1:40 developed in the serum from the partridge and of at least 1:80 in the pheasant and fell as clinical signs disappeared, although positive titres were still present 10 months after injection. It is interesting to compare these results with those of McDiarmid (1960) who attempted to transmit the disease direct from naturally infected to healthy pheasants using a suspension of

unfiltered sinus mucus injected into the sinuses. Only 1 young pheasant out of a total of 3 developed mild clinical signs. Three others injected with a filtrate from the same material remained normal. He also injected 2 groups of 3 chickens in the same manner. None of the 6 fowls developed clinical signs.

From the above experiments, it appears that the virulence of the infectious agent to birds is enhanced by passage through turkeys. Young turkeys also appear to be more susceptible than adult turkeys and domestic fowls.

Conclusions

This outbreak of sinusitis in pheasants was associated with organisms of the pleuropneumonia-like group; embryo inoculations, cultural methods and morphological appearance of the organisms established the presence of the non-pathogenic type, whilst the clinical signs, rate of spread, results of serological examinations, microscopical appearance of sinus exudate and results of transmission experiments, all indicated the probable presence of the pathogenic type. It is obvious, however, that considerably more work is needed to clarify the part these organisms play in the disease. Clearly, more than one strain of P.P.L.O. is involved and it is essential that these should be identified.

Vitamin A deficiency may conceivably have played a part in this outbreak and in future investigations it would be advisable to carry out vitamin A estimations on the livers of affected birds, although in further outbreaks no evidence of vitamin A deficiency has so far been found. Also the importance of eliminating the possibility of pox and Newcastle disease infections, cannot be over emphasised.

It is not possible to draw any definite conclusions regarding the source of the infection to game birds. The evidence suggests, however, that young birds may become infected from domestic fowls which are used as foster parents, broody hens being utilised for this purpose. It seems unlikely that the disease spreads among wild game birds and there is little likelihood of pheasants and partridges infecting domestic poultry under ordinary cirumstances.

Acknowledgments.—The author wishes to thank Dr. A. McDiarmid, D.SC., PH.D., M.R.C.V.S., of the A.R.C. Field Station, Compton, and Mr. A. D. Middleton of the I.C.I. Game Research Institute for the interest they showed in this work and for help in obtaining specimens.

Dr. J. F. Crawley, D.V.M., of the Connaught Medical Research Laboratories, University of Toronto, kindly provided materials and antigen for the P.P.L.O.-H.I. test.

Invaluable assistance was given by Mr. R. H. Duff, M.R.C.V.S., and Miss J. M. Macdonald, A.I.M.L.T., at the veterinary laboratory, Lasswade, Midlothian, in the identification and isolation of *Mycoplasma*, and without their help, little progress would have been made.

Messrs. J. Muskett and P. Wyeth provided technical assistance and the photographs were taken by Mr. R. Sayers.

References

ADLER, H. E. (1960). *Ann. N.Y. Acad. Sci.* **79.** 703.
CHU, H. P. (1958). *Vet. Rec.* **70.** 1,064.
———, & NEWNHAM, A. G. (1959). *16th Int. vet. Congr.* **1.** 163.
DELAPLANE, J. P., ERWIN, L. E., & STUART, H. O. (1934). *Bull. R.I. agric. Exp. Sta.* No. 244..
DOBSON, N. (1937). *J. comp. Path.* **50.** 401.
EDWARD, D. G. (1954). *J. gen. Microbiol.* **10.** 27.
FAHEY, J. E., & CRAWLEY, J. F. (1954). *Canad. J. comp. Med.* **18.** 264.
GIANFORTE, E., JUNGHERR, E., & JACOBS, R. E. (1955). *Poult. Sci.* **34.** 662.
HOFSTAD, M. S. (1959). "Diseases of Poultry." Iowa State College Press. 4th edn. p. 455.
JENNINGS, A. R. (1954). *J. comp. Path.* **64.** 356.
JERSTAD, A. C., & HAMILTON, C. M. (1948). *Poult. Sci.* **27.** 802.
KEYMER, I. F. (1958). *Vet. Rec.* **70.** 713.
LOCKE, R. D. (1959). Personal communication.
MCDIARMID, A. (1960). Personal communication.
MCKAY, K. A., & TAYLOR, J. R. E. (1954). *Canad. J. comp. Med.* **18.** 7.
MEYER, K. F. (1959). "Diseases of Poultry." Iowa State College Press. 4th edn. p. 529.
MIDDLETON, A. D. (1960). Personal communication.
OSBORN, O. H., & POMEROY, B. S. (1958). Avian Diseases. 2. 370.
ROEKEL, H. VAN, & OLESIUK, O. M. (1953). *Proc. 90th Ann. Meet. Amer. vet. med. Ass.* 289.
WICHMANN, R. W. (1957). Avian Diseases. **1.** 222.

THE FITZWYGRAM, LAWSON, WALLEY AND WILLIAMS COMBINED PRIZE FUND

We are asked by the Royal College to publish the following Ministry of Education notice:—

Notice is hereby given that the Minister of Education proposes after the expiration of one calendar month to establish a scheme under the Charities Act, 1960, for the above Foundation.

The proposed scheme may be inspected on any week-day, except Saturday, during 21 days from this date between 10 a.m. and 4 p.m. at the office of the Registrar, The Royal College of Veterinary Surgeons, 29/31, Wright's Lane, Kensington, London, W.8. Copies can be obtained at the Ministry of Education (Legal Branch), Curzon Street, London, W.1.

Representations may be sent in writing within one calendar month from this date to "The Secretary, Ministry of Education (Legal Branch), Curzon Street, London, W.1," quoting the following reference No. U.2158Z/23.

THE RESEARCH DEFENCE SOCIETY

The 30th Stephen Paget Memorial Lecture entitled "On Taking Account of Public Opinion" will be delivered by Sir Hugh Linstead, O.B.E., LL.D., F.P.S., M.P., on Tuesday, November 21st, 1961, at 5.30 p.m. in the Physiology Lecture Theatre, University College, Gower Street, London, W.C.1. All members of the Society and their friends will be welcome. The Annual General Meeting of the Society will be held after the lecture.

The Effect of Humidity on the Lesions of Streptothricosis

BY

I. MACADAM

Federal Department of Veterinary Research, Vom, Northern Nigeria

SUMMARY.—1. *An experiment is described whereby 4 cattle were kept in high humidity and 4 in low humidity. After experimental challenge with 19 strains of* Dermatophilus congolensis *the lesions of the bulls in high humidity became cured before those of the other bulls.*

2. *The variations of infectivity of strains is described.*

3. *Humidity as a factor in relation to the lesions is discussed.*

ECONOMICALLY, the contagious bovine dermatitis, called streptothricosis (Austwick, 1958) is of great importance to many African countries due to damage to hides and as a major cause of debility, with occasional deaths. The factors involved in the spread of this disease during the rainy seasons need elucidating. Vectors, especially ticks, are important (Plowright, 1956). The marked regression of the disease with the onset of the dry season has led many workers to consider that humidity was one of the main factors involved. Curasson and Mornet (1941) and Curasson (1942) in Senegal, considered that infected areas of skin developed active lesions under the influence of humidity.

Chodnik (1956) believed that humidity was the main factor determining the course of the disease, which he called mycotic dermatitis, in Ghana. He found that the lesions in 10 cattle spread after 7 to 10 days in high humidity. Bugyaki (1959), in the Congo, was of the opinion that excessive humidity increased lesions. The present work describes the results of skin scarification and rubbing in of 19 strains of the causative organism, *Dermatophilus congolensis* Van Saceghem (1915 emend. 1916 and 1934) (Austwick, 1958), in 8 bulls under conditions of high and low humidity.

Materials and Methods

Eight yearling White Fulani Zebu cattle of similar weight and condition were made available from the flying herd of young bulls used for testing vaccines made in these laboratories. The back of each animal was shaven on 20 sites 5 cm. in diameter, and 6 incisions 2 mm. deep and 4 cm. long, were made on each site. On each bull one site was left uninoculated and each of the remaining sites was swabbed with 2 ml. of a peptone water culture of one of 19 strains of *D. congolensis* on February 10th, 1961, and again 4 days later. In order to study any variations in virulence it was felt necessary to use the whole collection of 19 strains. The experimental reproduction of lesions has been generally difficult and unsatisfactory. Seventeen of the strains were from cattle in Vom. Two of these, S.13/4 and S.30/6 were isolated and dried *in vacuo* in October, 1955 (Plowright, 1956). They survived 61 months *in vacuo* at 4° C. Strain 176 was from an old Friesian grade cow which died from the disease at Agege, Lagos. K. strain came from Keffi in Benue Province.

Four cattle were housed in pairs in 2 loose-boxes, 8 feet 6 inches × 6 feet 9 inches × 10 feet 10 inches high, that is, about 310 gross cu. ft. per animal. To attain high humidity water was sprayed on the walls twice daily, ventilation was minimal and bedding was not removed. The other 4 cattle were left out in fenced paddocks. Water, atcha hay and groundnut cake were given *ad lib.* to the housed cattle and for 2 hours each morning to the outdoor cattle.

Wetting of the skins in this experiment occurred only during the weekly dipping of the grazing cattle. The cattle were free from ectoparasites. There was no rain or dew and no water was sprayed on the housed cattle. All cattle were examined and temperatures taken daily between 7 and 8 a.m. The temperature and relative humidity of the air inside the boxes were measured daily at 10 a.m. Outside shade data were available from routine meteorological readings taken at 10 a.m. daily.

To recover the organism the largest loose scab was pulled off, flamed and scraped to remove hairs and scales. A sterile wire was used to dig into the underside; the loose flakes fell on to blood agar. Plates were incubated at 37° C. in a jar with a lighted candle, as the organism was found to be microaerophilic.

After artificial infection the characteristic lesions developed usually along the length of the incision, though sometimes only at intersections of incisions. The number of incisions showing lesions on each site was counted daily. The total number of infected incisions was calculated for each strain daily and virulence was estimated from the number of "lesion-days."

Results

By the sixth day lesions appeared on most of the incisions and by the tenth day they were typical of the natural disease, there being 61 on the 4 housed bulls compared with 265 on the grazing bulls, 3 of which showed them on every swabbed site. No lesion was seen on the control sites. The lesions of the housed bulls healed 12 to 15 days after the first swabbing; those of the grazing bulls after 18 to 28 days.

Tables I and II and the graph show the daily numbers of lesions.

The tables and graph show that the cattle in the high humidity showed fewer lesions and healed 13

TABLE I
NUMBERS OF LESIONS ON CATTLE IN HIGH HUMIDITY

Animal number	Number of days after inoculation 10	11	12	13	14	15
965	18	17	11	11	5	0
969	7	5	2	0	0	0
993	35	28	19	17	5	0
994	1	1	0	0	0	0
Total	61	51	32	28	10	0

TABLE II
NUMBERS OF LESIONS ON CATTLE IN LOW HUMIDITY

Animal number	Number of days after inoculation 10	13	16	19	22	25
5	28	40	7	0	0	0
7	92	85	50	44	31	17
960	53	32	6	0	0	0
1,005	92	86	49	34	21	9
Total	265	243	112	78	52	26

days earlier than those grazing in low humidity. No lesions spread beyond the sites, although several became confluent and in some cases the whole site was covered. As estimated by the number of lesions and their persistence there appeared to be variations in virulence among the 19 strains.

Many lesions were friable and crumbling away by the 14th day; however, the organism was recovered from 5 mm. diameter lesions from 4 sites on a housed bull and 2 on a grazing bull. On the 20th day lesions from 8 sites on the 2 remaining affected grazing cattle produced many colonies of the organism. A total of 14 lesions were cultured and the organism recovered from all.

Conditions inside the 2 boxes were almost identical; the temperature was 73° to 82° F. (mean 77.4° F.); relative humidity 80 to 96 (mean 90) per cent. Over the same period, February 10th to 27th, 1961, the outside shade temperature maxima were between 76° and 87° F. (mean 83.3° F.), and minima from 51° to 64° F. (mean 57.6° F.), while the relative humidity measured daily at 10 a.m. varied from 8 to 17 (mean 13.5) per cent.

The temperatures of the housed cattle varied from 99.2° to 102.8° F. (mean 101.5° F.), while those of the grazing cattle varied from 95.0° to 101.2° F. (mean 97.7° F.). On average the temperatures of the housed cattle were 4.0° F. higher. The housed animals were put out to grazing on February 27th and during the next 11 days their temperatures were 97.0° to 100.6° F. (mean 98.9° F.), while those of the other 4 bulls were similar.

Discussion

Streptothricosis shows a much higher incidence during the rainy season than in the dry season and it has been thought that high humidity was one of the main factors in the spread of this disease. However, the effect of the dry season on the ecology is markedly different from that of the wet season, during which insects and ticks multiply rapidly,

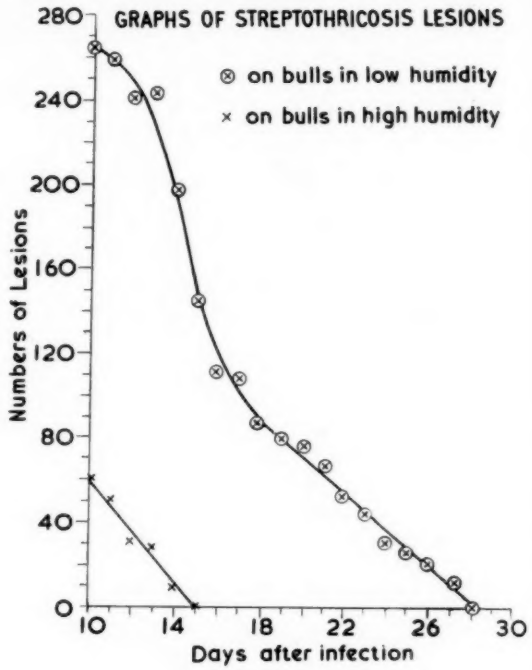


FIG. 1.

plant growth is luxuriant and provides ample cover. The effect of humidity alone on streptothricosis should be considered separately from the effect of other factors which may be directly associated with humidity.

Increasing the humidity affected other factors, such as atmospheric and rectal temperatures and respiration. The cattle in the paddock habitat were exposed to sunlight while those in the boxes had none. During the experiment the intensity of the sun's rays was greatly reduced by the dry-season dust.

The increase of 4° F. in rectal temperatures would not affect the organism which grows well at 39° C. (102° F.). The bad ventilation and increased CO_2 content would encourage growth of the organism.

Conclusions

It was concluded that, far from causing the spread, high humidity in this experiment was associated with the healing of the lesions of streptothricosis. Cattle varied in their susceptibility to artificial infection with *D. congolensis*. Different strains showed variations in infectivity and virulence as estimated by size and persistence of the characteristic lesion.

Acknowledgments.—The author is grateful to Mr. E. P. Lindley, Deputy Director, for advice, and to the Director of Veterinary Research, for permission to publish.

References

AUSTWICK, P. K. C. (1958). *Vet. Rev. Annot.* 4: 33. 48.
BUGYAKI, L. (1959). *Bull. Off. Int. Epiz.* **51**. 237.
CHODNIK, K. S. (1956). *J. comp. Path.* **66**. 179.

(*Concluded at foot of adjoining column*)

Rupture of the Uterus in the Parturient Ewe

BY

A. R. O'NEILL

Ballinrobe, Co. Mayo

IN recent years there has been an increasing tendency for farmers to attempt to correct postural abnormalities of the foetus in the parturient ewe, and this has resulted in the growing number of cases of rupture of the uterus one meets in ovine obstetrical practice. Rupture will occasionally occur without any outside interference following prolonged labour, particularly with breech presentations, but the commonest cause of the condition is undoubtedly manipulation of the foetus. A selected number of the cases met with in this practice have been successfully treated by laparotomy followed by, in one case, a blood transfusion.

Diagnosis

Immediately after the normal delivery of a lamb it was routine practice to carry out a manual examination of the uterus for evidence of damage. The commonest sites for ruptures to occur were:—

1. The junction of the horn with the body of the uterus.
2. The dorsal and lateral aspects of the body of the uterus.
3. The cervix.

Where a rupture had occurred during an unsuccessful attempt to deliver the lamb the following symptoms were observed:—

1. The distressed condition of the ewe—laboured breathing, shocked appearance, grinding of the teeth, disinclination to remain standing for any length of time.
2. Anaemic appearance of the conjunctiva, gums, lips and tongue.
3. Prolapse of the intestine through the vulva.
4. Bleeding from the vulva.

In these cases, while carefully examining the uterus, particular attention was given to the parts over those bony prominences of the lamb which were close to or against the pelvic girdle of the ewe.

Treatment was not attempted in the following circumstances:—

1. Where manual examination showed irreparable laceration of the uterus.
2. Where there was prolapse of a large portion of the intestine which was bruised or torn and detached from the mesentery.
3. When the ewe was suffering from an advanced toxaemia.
4. When the ewe was obviously dying from shock and haemorrhage.

The amount of haemorrhage which occurs varies with the position of the rupture. Uterine arteries descend in the uterine broad ligament above the level of the junction of the horn with the body of the uterus (Browne, 1947) and ruptures about this point particularly are accompanied by very severe haemorrhage.

Surgical Technique

Epidural anaesthesia using 3 c.c. of local anaesthetic* was used in all cases. The ewe was placed on her back on the table, with the head and fore part of the body held slightly higher than the hind part. Paralysis of the splanchnic nerves, with a resultant serious drop in blood pressure, will occur if the anaesthetic is allowed to run forward to the posterior thoracic region (Wright, 1959).

The site chosen was mid-line and it was prepared by plucking the wool, washing with soap and water and disinfecting with Penotrane tincture.† The mammary gland was pushed back to allow the incision to begin as close to the pubic symphysis as possible. It was found that this site allowed one to draw the greater portion of the uterus right out of the abdominal cavity, and this greatly facilitated the task of repairing the rupture.

Procedure

An abdominal incision about 6 inches long was made and the position of the uterine rupture determined. If the lamb was still *in utero* and the rupture was in the uterine horn, the lamb was delivered through it. Any extension of the opening that was required was made with a scissors and directed away from the cervix. If, however, the body of the uterus was involved, and there was danger of the tear extending itself back towards the cervix or around the body of the uterus, a separate incision was made in the anterior portion of the horn to deliver the lamb.

The foetal membranes were removed if they came away without any difficulty.

The uterus was then drawn as far out of the abdominal cavity as possible, thus exposing the damaged part. Haemorrhage from the larger blood vessels was brought under control by artery forceps, torsion or ligature as required. Badly damaged tissue was cut away.

Suturing with continuous Lembert sutures was then begun, starting at the posterior end of the tear and working forward. Reaching the distal end of the rupture was often quite difficult owing to the contraction of the uterus. Monofilament nylon was used in all cases for suturing both the uterus and

* Ravocaine: Bayer Products.

† Penotrane: Ward, Blenkinsop & Co., Ltd.

The Effect of Humidity on the Lesions of Streptothricosis.—*Concluded.*

CURASSON, G. (1942). "Trait. Path. Exot. Vet. Comp." 2nd ed. Vol. 2. P. 152.

———. & MORNET, P. (1941). *Bull. Serve. Zoo. Epiz.* Afr. occ. Fr. IV. 3. 181.

PLOWRIGHT, W. (1956). *Vet. Rec.* **68.** 350.

abdominal wall. Its use in the uterus is rather unorthodox, but it has been employed in this practice for some years in caesarean sections in the ewe, cow, bitch, mare (Daly, 1959) and donkey, and it has given every satisfaction. No attempt was made to preserve the natural conformation of the uterus, sutures being placed where they most effectively repaired the rupture.

The peritoneal cavity was drained thoroughly by tilting the ewe to one side and allowing the fluids and blood clots, etc., to run away, followed by swabbing. The contents of two intramammary tubes of penicillin were injected into it. The abdominal wound was then closed by a continuous suture including the peritoneum and muscle layers, interrupted sutures being used for the skin.

After epidural anaesthesia the ewe does not have the use of her hind legs for some 2 to 3 hours, and if she is not prevented from dragging her hind quarters behind her she is likely to injure her back or damage the abdominal sutures. Tying a foreleg to the opposite back one is a simple and effective safeguard.

One million units of both sodium and procaine penicillin were given at the time of the operation and procaine penicillin (1,000,000 units) was given for a further 2 to 3 days as required. Glucose saline was given by stomach tube immediately after the operation and any other nursing was left to the owner. Five ewes treated last season grazed normally the following day while suffering from a diarrhoea which persisted for a day or two only.

Tears in the Uterine Cervix

Tearing of the cervix will occur from time to time whilst effecting the normal delivery of lambs with, in many cases, little if any haemorrhage. If the tear is right through the organ haemorrhage will be profuse and stitching will be necessary. Most cases can be satisfactorily dealt with, without recourse to laparotomy, if the ewe is given an epidural anaesthetic and placed on the table with the fore part of the body well raised. In this position the cervix can be sufficiently exposed by traction, *via* the vagina, to permit the repair of the wound, using one or two deep sutures to compress the larger blood vessels.

Blood Transfusion

One ewe, which collapsed following a severe uterine haemorrhage, was given a blood transfusion with spectacular results. The blood was taken from the first suitable donor that was available—a ram brought into the surgery for treatment for foot-rot. About 400 c.c. of blood was taken from the left jugular vein of the ram, the ram being held in the "begging dog" position. The blood was allowed to flow directly into a 500-c.c. bottle which contained 1.5 g. of sodium citrate dissolved in 60 c.c. of water. The ewe was then held in a similar position to the ram and the blood was transfused into one of her jugular veins using a flutter-valve apparatus. The bottle of blood was held slightly higher than the level of the ewe's head. There was an immediate and marked improvement in the general health of the ewe. She lifted her head and took notice of her surroundings within a short time. She was then given 2 pints of glucose saline by stomach tube and her recovery continued. The following day the fluid therapy was repeated and although still weak she grazed normally for short periods. Her further recovery was uneventful.

Discussion

In this district all the ewes are crossbred types and those which gave trouble at lambing time are culled. For this reason we have no record of any of the ewes, which were treated for rupture of the uterus, breeding again. In this past season a total of 8 cases were treated, and of these, 5 reared either their own or adopted lambs, 2, including the 1 which had the blood transfusion, lost their milk but otherwise did well, and 1 died.

Hughes Ellis (1958) advised slaughter in 3 of his cases on economic and humane grounds and mentioned the complication of lubricating oil in the peritoneal cavity. In this practice soap and water are used almost entirely for lubricating purposes, so that this complication does not arise and, from the economic point of view, the very low value of casualty ewes makes treatment a sound proposition for farmer and veterinary surgeon alike.

Acknowledgment.—I wish to thank my principal Mr. P. J. Daly for his advice and interest in the preparation of this paper.

References

BROWNE, T. G., Professor, Veterinary College of Ireland. Lectures on the Anatomy of the Domesticated Animals, 1947.

DALY, P. J. (1959). *Irish Vet. J.* **13.** 122.

ELLIS, T. HUGHES (1958). *Vet. Rec.* **70.** 956.

WRIGHT, J. G. (1957). "Veterinary Anaesthesia." Baillière, Tindall and Cox, London.

"AT BAY"

The following is quoted from a leading article in *The Times Educational Supplement*, under the title above.

"There is, however, one man of science who can outdo the family doctor any time he likes, and that is the veterinary surgeon. He is an enigma. We shall never know why he endured a longer course of study to care for animals rather than humans. Perhaps he cannot abide human kind. All is shrouded in mystery. Here is a man who can, if he must, communicate with the human world but is also on terms with the whole animal creation. Here is a man really to make an arts graduate squirm—in anger and embarrassment. If we keep a pet we are sentimental. But we cannot help that. At least we should try and be intelligent about looking after it. No, we cannot help to hold the creature while it is being examined. All right, we may try, but if we do it like that it is pointless, worse than useless. Clearly, we think, our only use is to prove that we are inferior to all dumb creatures and vets. Yet admit it, we have to—even an angry vet. can be a powerful comfort at times."

Current Literature

ABSTRACTS

Louping-Ill in the West of Scotland. ROSS, CONSTANCE A. C., & GOURLAY, CATHERINE H. (1961). *Lancet*. September 2nd, 1961. Pp. 527-8.

Though louping-ill has been recognised for many years as an infectious disease of sheep, natural infection of man with louping-ill has been reported in only 9 cases. In these the clinical illness was a meningo-encephalitis except for 4 cases whose illness resembled acute paralytic poliomyelitis.

As no large-scale survey has been carried out in this country to determine the incidence of infection in humans, the authors of this paper attempted to assess the importance of louping-ill in the west of Scotland by serological examination of patients with acute infections of the central nervous system.

The human sera examined came from 408 patients in the west of Scotland during the 2-year period January, 1959, to December, 1960: 374 had aseptic meningitis, 10 had a paralytic poliomyelitis-like illness and 24 had encephalitis or encephalo-meningitis. From all these patients paired sera were received—*i.e.* the specimen of serum taken during the first week of illness, and a second specimen taken during convalescence, generally 10 to 14 days after the first specimen. The material thus obtained was used for complement-fixation tests. Of the 408 patients only one showed serological evidence of infection with louping-ill. This patient was a sheep farmer with meningo-encephalitis. Clinical details of this case are contained in another paper, *Combined Scottish Study 1961* (in press).

It would appear from this study that in the west of Scotland louping-ill infection of man played little part in acute infections of the central nervous system in 1959-60.

However, during 1959-60 louping-ill was a serious disease of sheep in the area. Wilson (1961) reported that despite vaccination, there had been an increasing incidence of louping-ill infection in sheep in south-west Scotland including Argyllshire, culminating in several large outbreaks in the spring of 1960 with the death of many lambs and some sheep. The presence of louping-ill was confirmed by histopathological examination of brain specimens from affected animals or mouse inoculations. Serological examination also revealed a high incidence of louping-ill infection in lambs and ewes in the area. Central Scotland was apparently unaffected as no evidence of louping-ill antibodies was found in sera collected from 204 sheep and 314 cows in Stirlingshire from August to November, 1960. (It is not stated whether these sheep and cows in Stirlingshire were healthy or were sick animals.)

Reference

WILSON, A. L. (1961). Personal communication.

Latent Brucellosis in Farmers. MCWHINNEY, I., & PRIOR, A. P. (1961). *Brit. med. J.* July 8th, 1961. Pp. 80-1.

The subjects of this study were 20 volunteers from a general practice in Warwickshire. The group consisted of 13 farmers, 3 farm managers, one farm pupil and 3 farmers' sons. Their ages ranged from 19 to 73. No man known to have had undulant fever was included. Fifteen different farms were involved.

Brucellin skin tests were performed and serum agglutination tests carried out before and between 2 and 4 weeks after the first.

Taking a positive brucellin test or the presence of agglutinins to a titre of 1:40 as the criterion of latent infection, it was found that the latent infection rate was of the order of 70 per cent. of the group. From subsequent enquiries into their past medical histories it was concluded that 2 of the farmers had almost certainly suffered from undiagnosed undulant fever.

Comparative Tuberculin-testing of Human Subjects. STEWART, C. J., EMBLETON, D. P. F., & VAN ZWANENBERG, D. F. (1961). *Brit. med. J.* January 7th, 1961. Pp. 7-13.

The results of tuberculin-testing over 8,000 school children simultaneously with bovine and human P.P.D. (Weybridge) tuberculin, using the Heaf multiple-puncture technique, in 7 districts is described. The tests were carried out between May, 1958, and April, 1959. The stimulus to carry out this trial of comparative tuberculin-testing came from a history of infected milk supplies in the years 1953-54-55.

In 2 districts known to have had a supply of milk infected with tubercle bacilli, and in which there has since been a high incidence of non-respiratory tuberculosis, more reactors to bovine P.P.D. tuberculin were found than to human P.P.D. tuberculin and the reactions to bovine tuberculin were larger than to human tuberculin.

In 2 towns with a known clean milk supply and a low incidence of non-respiratory tuberculosis there were more reactors to tuberculin of the human strain, and these reactions were larger than those to the bovine strain. This evidence suggests that comparative tuberculin-testing of human subjects with the bovine and human strains of P.P.D. tuberculin may differentiate between human and bovine sources of infection. G. F. B.

A Practical Serologic Test for Trichinosis. SUESSENGUTH, HAZEL, BAUER, A. H., GOLDSTEIN, H., & GREENLER, A. M. (1961). *J.A.V.M.A.* **139.** 574.

This article describes the Suessenguth-Kline flocculation slide test for trichinosis in which 0.05 ml. of serum is mixed with antigen emulsion on a slide, and the slide rotated for 4 minutes at 120 r.p.m.

Twenty-four pigs were fed infective trichinella larvae and all developed positive reactions which persisted throughout the fattening period. Three pigs kept for over 4 years still gave a positive reaction when slaughtered. Control pigs and pigs fed sterilised infected meat gave negative reactions.

It is considered that this test could be applied to all pigs entering a slaughterhouse and that it is an improvement upon existing methods of testing for trichinosis.

Divisional News

THE NORTH OF SCOTLAND DIVISION

The Annual General Meeting of the Division was held in the Northern Hotel, Aberdeen, on June 28th, 1961. There was an attendance of 34 members and guests with the President, Mr. F. A. Davidson, in the chair. Apologies for absence were received from Messrs. Hardwick, Buie, Watson, Robson, Leitch, Argo and Mackenzie.

On a motion from Mr. W. Rice the Minutes of the previous meeting were approved as read.

The secretary read correspondence from the General Secretary, B.V.A., dealing with the proposed new method of establishing Divisional representation on Council, and another on the need for education of farmers on the care to be used in injections, particularly in pigs, because of the very great increase in the number of cold abscesses being found in carcases.

Resignations from Miss Gilchrist and Mr. E. Argo who have moved from the district were accepted.

Mr. D. Gracey, Longside, was nominated and elected to membership.

Since both B.V.A. representatives had been unable to be present at the meetings their report was forgone for this meeting.

Mr. J. Norval gave a paper which dealt with the routine to be followed in respect of casualty animals coming to the slaughterhouse. From his experience he spoke of the various reasons for the "casualty animal" and the possibility of the carcases being condemned. He pointed out the need for a case history—not a diagnosis—accompanying the certificate requesting entry into the slaughterhouse. He spoke of the occasions, and the routine to be followed, when it was impossible on grounds of cruelty to transport animals to a slaughterhouse. He gave figures detailing the usual causes for casualty animals at his own slaughterhouse with their varying percentage occurrence.

The discussion was opened by Mr. A. Skea who asked Mr. Norval a number of questions, and thereafter many of the members joined in the discussion. The meeting was summed up by the President who spoke of the need for the greatest care in meat inspection and of the assistance that could be obtained from *ante-mortem* inspections so long as they were performed by veterinary surgeons.

Following tea the business of the A.G.M. was conducted. The treasurer presented his report, which showed a comfortable balance. The report was adopted on a motion from Mr. A. Skea.

It was unanimously agreed that the loss incurred by the Ladies' Guild, because of the cancellation of their dance as the result of a foot-and-mouth outbreak, should be met from Divisional funds. It was also agreed that the usual subscription of £10 be sent to the V.V.B.F.

The following office bearers and members of Council were elected for the season 1961-2:—

President, M. MacLellan; Senior Vice-President, E. F. Hardwick; Junior Vice-President, J. Suttie; Past President, F. A. Davidson; and Secretary and Treasurer, A. Semple. Members of Council: Messrs. P. L. Shanks, R. S. Cowie, J. Martin and J. Lyon. It was unanimously agreed that the existing representatives to B.V.A. Council should continue in that office. They are E. F. Hardwick and W. J. B. Robson.

Before asking Mr. M. MacLellan to take up his office as President Mr. F. A. Davidson, retiring, summed up the year as one which had given him great satisfaction. The meetings had been interesting and well attended. It was unfortunate that one meeting had had to be cancelled because of the foot-and-mouth epidemic. Before leaving office he wanted to draw attention to the need for the greatest care in tuberculin testing, and particularly in the recording of the results. The history not only of the cattle being tested but also of those previously in the herd was very important.

Brucellosis could now get the attention it merited and the profession, Mr. Davidson felt, was on the verge of a campaign which would require the utmost assistance and skill. Swine fever, he said, was also marked for a new and vigorous policy, and although in their area they were singularly free from outbreaks, they must always be prepared for possible infection from pork products.

The great increase in the capital value in the poultry industry must mean that a far greater interest must be taken in it by the veterinary profession.

Mr. F. A. Davidson then called upon Mr. M. MacLellan to take the chair as President for the 1961-2 season.

THE AYRSHIRE VETERINARY ASSOCIATION

A meeting of the Division was held in the students' lounge at Auchincruive on October 5th. The minutes of the A.G.M. were read and their adoption as a true record was proposed by Mr. A. P. C. MacLaren and seconded by Mr. D. Moodie.

Arising from the Minutes

The following items were discussed: (1) Membership and bank balance. The secretary reported that the fully paid up membership was now 37. The bank balance was noted. (2) The direct sale to farmers by a firm of chemists of 5 per cent. procaine hydrochloride for dehorning. The secretary described the action he had taken. (3) Service on B.V.A. committees. The secretary reported that the B.V.A. had accepted the Division's nominations.

Apologies

Apologies were received from Mr. Matthew Miller, Paisley, and Mr. Hugh Begg, Strathaven.

Correspondence

The secretary read a letter from Mr. John McQuaker, Stranraer, who had tendered his resignation because of his retirement from active duty with the Animal Health Division at the end of October. Members received this intimation with regret but

agreed unanimously that an honorary life membership of the Association should be conferred on Mr. McQuaker.

Next Meeting

The next meeting would be held on November 2nd at Auchincruive. It would take the form of a general discussion and would be opened by Mr. W. A. Whiteford, Strathaven.

Other Items

(1) New members. Three names were submitted for membership: Miss E. V. H. Porter, Animal Health Division, Ayr; Mr. Gordon R. Craig, Galston; and Mr. B. A. Martin, Kilmarnock. (2) Benevolent Fund Dance. The secretary announced that the Benevolent Fund Dance would be held in Western House, Ayr, on November 23rd. (3) The President said he was certain that members would wish to offer congratulations to Mr. Moodie, a member of the Division, who had won the driving competition in the International Sheep Dog Championship that had taken place recently in Ayr.

Lecture by Dr. Kerr

The President then introduced the speaker, Dr. W. R. Kerr, Deputy Director, Veterinary Research Division, Northern Ireland. He welcomed Dr. Kerr as a true son of Ayr who had spoken at Divisional meetings on previous occasions and who had earned an international reputation as an authority on the subject of brucellosis. Dr. Kerr then gave a most interesting talk illustrated by lantern slides. An excellent discussion followed. Mr. D. Moodie proposed a vote of thanks to the speaker.

After the meeting members adjourned to the canteen where they had tea with several lady members of the County of Ayr Ladies' Guild who had met in a separate room to discuss the arrangements for the Victoria Veterinary Benevolent Fund dance.

Twenty-two members and 7 visitors signed the visitors' book. The sum of £4 was taken from the collection box for the Victoria Veterinary Benevolent Fund.

THE MIDLAND COUNTIES VETERINARY ASSOCIATION

The Annual General Meeting of the Association was held at Avoncroft Cattle Breeders Ltd., Stoke Prior, Bromsgrove, on May 12th, 1961. The President, Mr. T. B. Yarrow, took the chair. Twenty-four members and 11 visitors attended. Apologies were received from 21 members.

Minutes

The Minutes of the last Annual General Meeting held at Bromsgrove on May 20th, 1960, having been published, were taken as read, approved and signed.

Correspondence

The hon. secretary read 2 letters from B.V.A. headquarters: (1) concerning broken hypodermic needles in the flesh of food animals, and (2) concerning the method of electing the Council of the B.V.A.

Arising out of this Mr. J. A. Moss proposed that the meeting should approve the report of the subcommittee on election to the Council of the B.V.A. and Mr. J. H. McGhee seconded the proposal. Mr. J. B. Johnston, suggesting that this letter should be more carefully considered in view of the M.C.V.A. plans for re-organisation, proposed an amendment that the letter should be referred to the Council of the M.C.V.A. for consideration. This was seconded and approved by the meeting.

B.V.A. Council Report

Miss W. M. Brancker gave an account of the last meeting of the B.V.A. Council.

Hon. Secretary's Annual Report

The report was adopted.

The secretary said:—

"Membership of the Association now stands at 143, the same as last year. Seven new members were elected and we lost 7 members, 5 through resignation and 2 through death.

"The Association has enjoyed an active year. Six general meetings were held, and following the policy adopted by your Council, 4 of those meetings were held in conjunction with the 4 veterinary clubs in the area. The average attendance was 34, which was 7 more than the previous year.

"There were 4 Council meetings at which the average attendance was 9, and the subject which mainly occupied the Council was how to bring about closer co-operation between the Association and the veterinary clubs.

"The dinner and dance held at the Hotel Leofric on October 12th, in conjunction with the South East Midlands Veterinary Association, to celebrate the eradication of bovine tuberculosis, was successful though there was a comparatively small financial loss."

Hon. Treasurer's Report

In the absence of Mr. N. Spence this was read by the hon. secretary. The report was adopted.

Election of Office Bearers

The following Officers were elected for the ensuing year:—

President, Mr. J. A. Moss; Senior Vice-President, Mr. T. B. Yarrow; Junior Vice-President, Mr. I. G. Shaw; Hon. Treasurer, Dr. D., C. Croft; Hon. Secretaries, Messrs. J. Donald & Partners; Hon. Auditors, Messrs. C. G. Allen and J. H. McGhee.

Council Election

There were 4 nominations for 4 vacancies and the President put it to the meeting that Messrs. S. V. Collard, E. J. Hodgkinson, A. Steele-Bodger and T. F. Vallely should be declared elected. This was seconded by Mr. P. N. Hull and unanimously agreed by the meeting. Mr. E. Wilkinson then asked if there was a member of the M.C.V.A. on the Council of the Victoria Veterinary Benevolent Fund, and that this should be brought up at the next Council Meeting.

Induction of the New President

Captain Yarrow called on Mr. Moss and invested him with the President's chain of office and gown.

Mr. Moss expressed his thanks for the privilege of serving the Division during what should be an eventful year destined to alter the M.C.V.A., and he had no qualms in expecting help from the Council and from the secretary. His first duty was to propose a vote of thanks to Captain Yarrow who had worked hard during a year when there had been more meetings than usual as a result of the sub-committee's work.

Captain Yarrow replied saying that he had thoroughly enjoyed his year of office. He thanked the Council and the secretary for their help.

Paper by Mr. Jennings

The President then introduced the speaker, Mr. S. Jennings, who, he said, needed no introduction to his old Division and was an outstanding member, in practice, tutorial affairs and on the political side. Mr. Jennings then gave an address entitled "Some Aspects of Large-animal Surgery and Anaesthesia," which he illustrated with various instruments, and with films of operations. This was followed by a lively discussion in which most of the members present took part.

Mr. G. A. Treanor expressed the meeting's thanks for this excellent paper.

Revision of Rules of the Association

The hon. secretary read the new rules, and Mr. J. B. Johnston summarised the position. Mr. J. Murray proposed that the new rules be accepted, and Captain Yarrow seconded this. The motion was put to the meeting and carried unanimously.

Election to Membership

The following gentlemen, having been proposed and seconded, and recommended by the Council, were duly elected, namely Mr. G. F. Kershaw and Mr. A. M. Barker.

Nominations for Membership

Mr. J. W. R. Pearce, proposed E. R. Corrigall, seconded G. F. Kershaw; Mr. B. L. Edwards, proposed I. G. Shaw, seconded T. F. Vallely; Mr. J. Reid, proposed B. Simpson, seconded T. F. Vallely.

Any Other Business

Mr. E. Wilkinson raised the question of castration with rubber rings of lambs more than a few days old. The effects were very painful for a half to three-quarters of an hour, and he suggested that a member owning a cine camera should take films of this as evidence. Mr. M. Overton said that this should also be done on the debudding of calves without an anaesthetic.

Victoria Veterinary Benevolent Fund A.G.M.

The Annual General Meeting of the Victoria Veterinary Benevolent Fund was held in the Council Room of the Royal Veterinary College, Royal College Street, London, N.W.1, on May 30th, 1961.

The President, Mr. H. W. Dawes, C.B.E., F.R.C.V.S., was in the chair, and the following members were present:—

Messrs. H. E. Bywater, E. Clark, Major J. J. Dunlop, Mrs. H. I. Field, Mr. R. C. U. Fisher, Professor C. Formston, Dr. R. E. Glover, Mrs. D. I. Glover, Professor J. McCunn, Mr. Norman P. Male, Mrs. Erica I. Thomson, Miss V. Tillemont-Thomason and Major W. H. Wortley.

Notice of Meeting

The Secretary read the Notice convening the meeting, and the Minutes of the previous Annual General Meeting, held on May 25th, 1960, were taken as read and approved.

Apologies for Absence

These were received from the following members:—

Messrs. E. P. Barrett, J. T. R. Evans, J. A. Flynn, G. N. Gould, Professor R. Lovell, Messrs. W. R. McKinna, D. H. L. Madden, Professor A. Messervy, Sir John Ritchie, Captain W. Watt and Mr. E. Wilkinson.

President and Vice-Presidents

It was proposed and seconded that Mr. Dawes be elected President for the ensuing year, and the resolution was carried unanimously. The four Vice-Presidents, Captain T. M. Mitchell, Professor L. P. Pugh, Major J. Sumner and Sir John Ritchie, were then re-elected, and afterwards the Chairman proposed that Major J. J. Dunlop, M.C., should be re-elected as Honorary Secretary. This resolution was carried unanimously. Professor J. McCunn was re-elected as Hon. Treasurer, and the Auditors were also reappointed.

Annual Report and Statement of Accounts

The Chairman proposed that this should be taken page by page as copies had been circulated.

Pages 4 to 5 dealt with the benefactions. It was felt that this was a way of honouring those who had supported the Fund by bequest and otherwise, in the past. Pages 5 to 9 gave the Report and Accounts for the year ended December 31st, 1960. The special Gift Account on page 7 showed how successful the hard work of the Ladies' Guild had been, and also how the support from Ireland had increased. The help of the Ladies' Guild and of the Veterinary Medical Association of Ireland was very much appreciated. In the matter of subscriptions the Ladies' Guild has again contributed enormously to the Fund.

News and Comment

LEGAL NOTE

In the Queen's Bench Division of the High Court recently judgment for the sum of £5,000 was made in favour of Chute Farms Ltd. in an action against a member of the profession, Mr. H. Curtis. The subject of the action was alleged negligent treatment of a Thoroughbred yearling colt. In treating the colt for lameness, Mr. Curtis's assistant did not give an injection of anti-tetanus serum and the colt subsequently died from tetanus.

In giving judgment, Mr. Justice Elwes said that, in law, Mr. Curtis was vicariously liable for the negligence of his assistant. His Lordship had no doubt that a competent veterinary surgeon "called in to a horse with an injured foot through which tetanus corpuscles could enter, would inject without fail."

THE UNIVERSITY OF LIVERPOOL

Several important functions will take place next Saturday, October 28th. In the Philharmonic Hall, at 11 a.m., there will be held a Congregation for the conferment of honorary degrees upon: the Rt. Hon. Lord Birkett, Sir Geoffrey Crowther, Dr. G. E. R. Deacon, Professor Sir William Hodge, Professor Sir William Holford, Mr. M. J. Lighthill, Sir John Ritchie and Dr. W. R. Wooldridge. This ceremony will be followed by luncheon in the Adelphi Hotel to meet the honorary graduates.

In the afternoon guests will be invited to view the new buildings for mathematics (with oceanography) and veterinary science.

"THE INDEX OF VETERINARY SPECIALITIES"

A pharmacologist writes:—

The *Index of Veterinary Specialities* is a new publication which according to the publisher will be sent free of charge quarterly to practising veterinary surgeons. This index consists for the most part of a list of the various therapeutic agents used in vet-

---

Victoria Veterinary Benevolent Fund A.G.M. —*Concluded.*

It had been disappointing that appeals for Deeds of Covenant, while not exactly neglected, had certainly not been answered to any marked extent. If any member did wish, or knew anyone who might wish to contribute to the Fund under covenant, the necessary forms could be obtained from the Secretary.

Freehold Land at Winkton

A position had now been reached whereby a firm bid for some land at Winkton had been made, and the matter now remained to be settled between the V.V.B.F., the Charity Commissioners and the Trustees of the Dacombe Estate. It was hoped that before next year's meeting something concrete would be put before the meeting.

Sir John Ritchie

The honour awarded to Sir John Ritchie had been recorded; it had been noted with very great pleasure.

Schedule of General Fund Investment

It was considered that this was a good Schedule, and generally speaking, a very satisfactory one. It was sometimes suggested that the Fund was not generous enough, but it was felt that the basic financial position must be kept as sound as possible. The Balance Sheet also was in a very satisfactory condition. *It was moved and seconded that the Report be received.*

Both Mrs. H. I. Field and the Chairman then spoke of the splendid work done by Mrs. D. I. Glover, who, after 17 years' service as the Hon. Secretary and Treasurer, had vacated those offices. During her term the Guild's contribution to the Fund had increased from £150 to £1,500 a year.

After some discussion about the possibility of more subscriptions by covenant, and the advantages and disadvantages of various types of investment, the Report and Accounts were adopted.

Election of 10 Members of the Association to Serve on the Council

Before dealing with this item the Chairman paid a tribute to the late Mr. Arnold Spicer, and the members of Council stood in silence for a few minutes in recognition of his great work for the profession and for the Fund in particular.

Dr. R. E. Glover then nominated Mrs. E. I. Thomson as a successor on the Council to Mr. Spicer, and this proposal was agreed. The other 9 members were re-elected by a bloc vote which was carried unanimously.

A vote of thanks to Dr. Glover, who had kindly offered the Council Room of The Royal Veterinary College for the meeting, and had also entertained members to tea was carried enthusiastically, after which the chairman paid a very warm tribute to Mr. Francis, the Fund's Secretary, and to Mr. Shee. A vote of thanks to these gentlemen was carried unanimously.

erinary medicine arranged according to the system or organs mainly affected and including drugs acting on infections. The drugs are listed under their trade names, the active component being given in italics. The information includes the various preparations of the different drugs and the cost. The Index will certainly be a useful source of information, which is very difficult to obtain, presented in a convenient form. It is to be hoped that an alternative will be found for the sub-heading "Anti-diarrhoels" which is not only ugly, but very doubtful English.

PERSONAL

Dr. I. W. Rowlands has been appointed by The Zoological Society of London as Senior Research Fellow in Reproductive Physiology. He will take up his appointment on January 1st, 1962, and will be in charge of the Wellcome Institute of Comparative Physiology which is to be built in the Society's grounds next year. For the last 12 years Dr. Rowlands has worked at the Institute of Animal Physiology, Babraham, Cambridge, on problems concerned with the ovarian cycle of mammals. Before this, he worked at the Wellcome Veterinary Research Station, Frant, Sussex.

Births

BEESLEY.—On October 3rd, 1961, to Constance, wife of Colin J. Beesley, M.R.C.V.S., Cotswold Lea, Moreton-in-Marsh, Glos., a daughter, Caroline, sister for Gillian.

MOORE.—On October 9th, 1961, at 47, Chaldon Common Road, Chaldon, Surrey, to Morag, wife of Bryan Moore, B.VET.MED., M.R.C.V.S., a son, Duncan Michael.

Engagement

MIDDLETON—JACKSON.—The engagement is announced between Nigel Trevor Middleton, B.V.M.S., M.R.C.V.S., only son of Mr. and Mrs. W. H. Middleton, of Bramhall, Cheshire, and Jennifer Cecilia Jackson, S.R.N., S.C.M., only daughter of Mr. and Mrs. G. S. Jackson of Cambridge.

COMING EVENTS

October

23rd (Mon.). B.S.A.V.A. METROPOLITAN REGION. Meeting at the Royal Society of Medicine, 1, Wimpole Street, London, W.1, 7 p.m.

24th (Tues.). SOCIETY FOR THE STUDY OF ANIMAL BREEDING. Meeting at the Royal Society of Medicine, 1, Wimpole Street, London, W.1, 11.30 a.m.

25th (Wed.). YORKSHIRE VETERINARY SOCIETY. Annual Dinner and Dance at the Cairn Hotel, Harrogate, 7.30 p.m.

26th (Thurs.). WESTERN COUNTIES VETERINARY ASSOCIATION. Meeting at the Rougemont Hotel, Exeter, 2.15 p.m.

27th (Fri.). YORKSHIRE VETERINARY SOCIETY. Meeting at the Parkway Hotel, Bramhope, Leeds, 2.30 p.m.

28th (Sat.). B.S.A.V.A. NORTH WESTERN REGION. Meeting at the Queen's Hotel, Manchester, 7.30 p.m.

30th (Mon.). EAST YORKSHIRE CLINICAL CLUB. Meeting at the Talbot Hotel, Malton, 8 p.m.

November

1st (Wed.). LINCOLNSHIRE AND DISTRICT DIVISION. Assistants Meeting at the Eastgate Hotel, Lincoln, 7.15 p.m.

SOUTHERN COUNTIES VETERINARY SOCIETY. Meeting at the Royal Hotel, Winchester, 7.30 p.m.

2nd (Thurs.). R.A.V.C. DIVISION. Meeting at Bristol University Veterinary College.

AYRSHIRE VETERINARY ASSOCIATION. Clinical Meeting in the New Building, Auchincruive, 7.30 p.m.

NORTH WILTS. VETERINARY CLUB. Meeting at the Goddard Arms Hotel, Swindon, 7.30 p.m.

3rd (Fri.). A.V.T. & R.W. SOUTHERN REGION. Meeting at the Royal Veterinary College, Royal College Street, Camden Town, N.W.1, 2.15 p.m.

4th (Sat.). B.S.A.V.A. SOUTHERN COUNTIES REGION. Meeting at Westcroft, Elm Lane, Earley, Reading, 7.30 p.m.

7th (Tues.). B.S.A.V.A. REGION 3. Meeting at Allen & Hanburys, Ware. Closing date for applications, November 1st.

9th (Thurs.). V.V.B.F. DUMFRIES AND GALLOWAY DIVISION. Annual Buffet Dance at the Cairndale Hotel, Dumfries.

B.S.A.V.A. SUSSEX REGION. Meeting at the New Imperial Hotel, First Avenue, Hove, 8 p.m.

10th (Fri.). R.V.C. COMMEMORATION BALL. To be held at the Royal Veterinary College, Camden Town, N.W.1, 8 p.m.

14th (Tues.). B.V.A. FINANCE SUB-COMMITTEE. Meeting at 7, Mansfield Street, London, W.1.

15th, 16th and 17th (Wed., Thurs. and Fri.). B.V.A. Committee and Council Meetings in London.

16th (Thurs.). V.V.B.F. NORTHERN DIVISION. Annual Dinner Dance in the Northern Hotel, Aberdeen, 7.30 p.m.

18th and 19th (Sat. and Sun.). B.S.A.V.A. SOUTH WEST AND SOUTH WALES REGION. Clinical weekend at the Clifton Zoological Gardens, Bristol.

23rd (Thurs.). V.V.B.F. COUNTY OF AYR LADIES' GUILD. Annual Buffet Dance in the Western Hotel, Ayr, 8 p.m.

THE REGISTER OF VETERINARY SURGEONS

Under the provisions of Section 6 of the Veterinary Surgeons Act, 1881, and Section 13 of the Veterinary Surgeons Act, 1948, the name of Mr. Robert Forbes Gray was removed from the Register of Veterinary Surgeons on October 12th, 1961.

ADDRESSES OF DISEASE INFECTED PREMISES

The list given below indicates, first the date on which disease has been confirmed, followed by the postal address and local authority.

Anthrax

October 11th, 1961. Mrs. D. A. Stenhouse, Northend Farm, Melbury Osmond, Dorchester, Dorset (Parish: Melbury Osmond). (Cattle.) DORSET.

October 16th, 1961. R. P. Phillipson, Nook Farm, Urswick Road, Ulverston, Lancs. (Parish: Ulverston). (Cattle.) LANCASHIRE.

October 16th, 1961. H. Gamble, Chapel Farm, Cottam, Retford, Notts. (Parish: Cottam). (Cattle.) NOTTINGHAMSHIRE.

Fowl Pest

October 10th, 1961. S. T. Townshead, Overgate Farm, Hockering, Dereham, Norfolk. NORFOLK.

October 10th, 1961. S. N. Parker, Homestead, Hill Top Avenue, South Benfleet, Essex. ESSEX.

October 10th, 1961. Mrs. A. S. Kent, Holmlea, Seething, Norwich, Norfolk. NOR 35W. NORFOLK.

October 10th, 1961. Mrs. A. Olkowicz, 12, Woodstock Avenue, Slough, Bucks. BUCKINGHAMSHIRE.

October 10th, 1961. Swannington Manor Farms Ltd., Dairy Farm, Alderford, Norwich, Norfolk. NORFOLK.

October 10th, 1961. Swannington Manor Farms Ltd., Hall Farm, Swannington, Norwich, Norfolk. NOR 82X. NORFOLK.

October 11th, 1961. Mrs. E. Gould, Mendip View, The Hayes, Cheddar, Somerset. SOMERSET.

October 11th, 1961. J. C. Frost Ltd., High View Turkey Farm, London Road, Attleborough, Norfolk. Disease at: Dial Farm, Suton, Wymondham, Norfolk. NORFOLK.

October 11th, 1961. E. H. A. Hill, Brynhyfryd, Bryngarm, Pencoed, Glam. GLAMORGAN.

October 11th, 1961. H. E. Rabbitt, Fairmead, Duffield Park, Stoke Poges, Slough, Bucks. BUCKINGHAMSHIRE.

October 11th, 1961. Mrs. M. Kiriemko, Felinsadeg, Llangannan, Denbigh. DENBIGHSHIRE.

October 11th, 1961. Mrs. T. E. H. Davies, Rosewhyn, Newcastle Emlyn, Carms. CARDIGANSHIRE.

October 11th, 1961. H. S. Proctor, 60, Rosebank, Ebrington, Chipping Campden, Glos. GLOUCESTERSHIRE.

October 12th, 1961. G. Childs, 43, Westcott Way, Uxbridge, Middx. Disease at: Orchard Piggeries, Packet Boat Lane, Cowley, Uxbridge, Middx. MIDDLESEX.

October 12th, 1961. E. Lines & Son, 23, Fitzwilliam Street, Swinton, Mexborough, Yorks. YORK, WEST RIDING.

October 12th, 1961. E. Coombs, 8, Hicks Avenue, Greenford, Middx. MIDDLESEX.

October 13th, 1961. B. Bowdrey, 5, Isis Way, Bourne End, Bucks. BUCKINGHAMSHIRE.

October 13th, 1961. M. Stacey, Bridges Moor, Luxulyan, Bodmin, Cornwall. CORNWALL.

October 14th, 1961. A. Taylor, 4, Station Road, Ashvale, Aldershot, Hants. SURREY.

October 14th, 1961. N. B. Vince, Wood Farm, Bawdeswell, Dereham, Norfolk. NORFOLK.

October 14th, 1961. Jenners Farms Ltd.; Lychgate Farm, Arterial Road, Rayleigh, Essex. ESSEX.

October 14th, 1961. H. Winter, The Bungalow, Morley St. Botolph, Wymondham, Norfolk. NORFOLK.

October 14th, 1961. L. F. Jordan, Lebanon, Mount Road, Thundersley, Essex. ESSEX.

October 14th, 1961. F. Clarke, Elms Farm, Gt. Barton, Bury St. Edmunds, Suffolk. WEST SUFFOLK.

October 15th, 1961. R. Parker, 112, Kiln Road, Thundersley, Essex. ESSEX.

October 16th, 1961. R. F. Hoddinott, Simmons Farm, Harberton, Totnes, Devon. DEVONSHIRE.

October 16th, 1961. T. G. Gibbons, 1, Kalvin Gardens, Southall, Middlesex. Disease at: Riverside Piggeries, Packet Boat Lane, Cowley, Uxbridge, Middlesex. MIDDLESEX.

October 16th, 1961. Miss K. Jones, Hendre, Bodvan, Pwllheli, Caernarvonshire. CAERNARVONSHIRE.

October 16th, 1961. F. E. James, Place Farm, Clavering, Saffron Walden, Essex. ESSEX.

October 16th, 1961. N. P. Wheeler, Mount Lodge, Biddenden, Ashford, Kent. KENT.

Swine Fever

October 10th, 1961. J. W. Jenkins, Bullens Well Farm, Llangennith, Swansea, Glam. GLAMORGAN.

October 10th, 1961. Messrs. T. W. Lea & Son, Rodington House, Rodington, Wellington, Salop. SHROPSHIRE.

October 10th, 1961. Mrs. M. Lewis, 5, Crumlyn Terrace, Tydraw Road, Bonymaen, Swansea, Glam. COUNTY BOROUGH OF SWANSEA.

October 11th, 1961. I. Roberts, Park Cottage, Hearts Heath, Mold, Flintshire. Disease at: Fferm Farm, Pontblyddyn, Mold, Flintshire. FLINTSHIRE.

October 11th, 1961. C. F. George, Harry Stoke Farm, Stoke Gifford, Bristol. GLOUCESTERSHIRE.

October 11th, 1961. A. Wood, Old Boston Farm, Haydock, St. Helens, Lancs. LANCASHIRE.

October 12th, 1961. J. Beardmore, 165, Holmcroft Road, Gorton, Manchester, 18. Disease at: No. 3 Holding, Highfield Estate, Levenshulme, Manchester. CITY OF MANCHESTER.

October 12th, 1961. F. Amos, Casebourne Farm, Horn Street, Hythe, Kent. Disease also at: Seabrook Vale Farm, Horn Street, Hythe, Kent. KENT.

October 13th, 1961. Mrs. J. S. Morton, Woodcote Manor, Bramdean Alresford, Hants. HAMPSHIRE.

October 16th, 1961. Messrs. Ruff Bros.; College Down Farm, Kilmeston, Alresford, Hants. HAMPSHIRE.

October 16th, 1961. A. Bullock, Golden Hill Farm, Bosley, Macclesfield, Cheshire. CHESHIRE.

October 16th, 1961. Bryn Thomas, Gellifowy Ganol Farm, Ynysmeudw, Pontardawe, Swanesa, Glam. GLAMORGAN.

October 16th, 1961. F. Drews, Penlan, Ferryside, Carmarthen. CARMARTHENSHIRE.

October 16th, 1961. S. A. Inns, El Paso, Lower Dunton Road, Bulpham, Upminster, Essex. ESSEX.

Letters to the Editor

The views expressed in letters addressed to the Editor represent the personal opinions of the writer only and their publication does not imply endorsement by the B.V.A.

GENERAL

Equine Veterinary Society

Sir,—A small group of members have been discussing the formation of an Association composed of veterinary surgeons concerned with the horse. The main object of the Association would be to encourage closer contact and collaboration between all members of the profession who have an interest in the horse, be they engaged in practice, teaching or research, to meet together to discuss and exchange ideas and opinions.

To assess the general feeling in the profession to the formation of such a specialist association a questionnaire was circulated to 240 members. The response has been most encouraging and I should like to take this opportunity to thank the many members who submitted comments both helpful and constructive.

The replies show that there is very considerable support for the formation of such an Association and therefore it is proposed to hold an inaugural meeting at 2.30 p.m. on Saturday, November 18th, in the Main Hall, Royal Veterinary College, Camden Town. All veterinary surgeons interested in the horse are invited.

Yours faithfully,
J. HICKMAN.

Department of Veterinary Clinical Studies,
Madingley Road,
Cambridge.
October 18th, 1961.

The Behaviour of Cattle in Crushes

Sir,—I should like to thank those who have contributed to this most useful discussion, particularly Mr. Ewbank for his original article in your issue of September 2nd last, and I hope that I may be allowed a few random thoughts on this subject. Surely the main reason for difficulty in controlling cattle both in "crushes" and elsewhere is first and foremost lack of previous handling? In other words these difficult cattle have not been "broken" in the way that a horse is broken to work. Of course a young vigorous beast which has been born and bred out of doors and suddenly finds itself confronted by fences, pens and "crushes" is apt to get "het up," and in such cases "rough handling" has little to do with the problem. It is the attendants and the veterinary surgeon who get the rough handling! On the other hand, young cattle which have been, as it were, hand-reared and which do not remember (owing to age) "what happened last time," are extremely easy to handle during a tuberculin test.

Memory of having been hurt at a previous test is often inevitable, nor should it be forgotten that non-specific reactions are quite painful ones. I do not subscribe to the view that a sharp "dental" type needle should be "gently inserted." I would almost prefer that such an insertion be made as a "jab." Yet we in practice surely recognise a middle way and rapidity of insertion is essential. We all know that a sharp 2-inch × 17-gauge needle can be inserted to its full length into a muscle with, very frequently, no response from the recipient whatever. But not by "gentle insertion." Holding an animal by its nostrils is unwise where cattle have been "well brought up" or shall we say "broken." "Nursing" the head in the arms is far preferable in such animals. Yet restraining an unbroken animal by its nose while an adjustable halter is applied is often quite necessary. Cattle handling crates are, of course, of widely varying efficiency. The best which has come my way is shown in Fig. 2 of Mr. Ewbank's article. This embodies a neck yoke inside the pen with a blanked-off door in front of the animal's head. However, there is no doubt that the ideal "crate" has yet to be evolved and I am in agreement with Mr. J. B. White that many are much too noisy. The use of rubber or other buffering at the noise spots could well be tackled by the makers.

To conclude, may I put on record what to me was a startling example of bovine memory? Some 14 years ago a farmer whose herd had been attested for several years but who had unhappily suffered a "breakdown" and had ceased testing, asked that I should retest the milking herd, after an interval of 40 months. Being unable to convince him of the futility of this procedure, I agreed to do so. Forty-six Ayrshire cows each chained by the neck in its stall, were subjected to the tuberculin test. All but one indulged in some degree of head-shaking on my approach. The one which stood quietly was the only cow which had been brought into the herd since the previous test and had not been tested.

Yours faithfully,
EDWARD WILKINSON.

216, Osmaston Road,
Derby.
October 15th, 1961.

Fees and Free Clinics

Sir,—Mr. Blythman is so right in everything he says in his letter to you published in THE VETERINARY RECORD of October 14th.

After 11 years' experience in an animal welfare hospital I can confirm all that he says about the need to remove the mystery of pricing, but would go further and emphasise the need once again for the profession to be more publicity conscious: I have so often found that people do not know of the existence of private veterinary surgeons and they have been grateful for information on this subject. I would like to see the day when our professional bodies are consulted as a matter of course on all press items affecting animal welfare rather than the welfare societies. I am sure that a periodical on the lines of *Family Doctor* for lay people would be a great help and could be published at a profit. It is also a pity that an organisation like the Animal

Health Trust hides its light under a bushel.

I think we must realise that animal welfare societies will always be with us and must try to ensure that they do the work for which they were intended and which is still, unfortunately, needed. There are also many fields in which the vast sums of money subscribed annually could be put to use in providing ancillary services which would help us as veterinary surgeons and, therefore, help our patients. It is to be regretted that we do not have enough "say" in the way such money is expended, and we should examine the problem of welfare societies as citizens rather than as veterinary surgeons. We should be much more interested in their general administration than we are at the moment. I find the mushroom growth of small local societies alarming and am disturbed by the lack of any Governmental control over the way in which charitable funds are spent. This applies to all charities, large or small, and not only to those concerned with animal welfare. The recent Charities Act has gone some way towards the control of new societies but still leaves many loopholes.

The general impression that the Charity Commissioners have some control is incorrect; they are chiefly concerned with the administration of specific trusts and not with monies bequeathed or subscribed for general purposes. It is felt that this should be the concern of individual subscribers but unfortunately so many people, having made their donation, are quite apathetic about what happens to it and do not attend Annual General Meetings or make use of any of the processes which are supposed to guard democratic institutions.

When discussing welfare societies we should try to avoid giving the impression that we are concerned only with a possible threat to our livelihood. As I have now left the welfare field, I may find that I, too, shall become somewhat shortsighted on this subject, but hope that I shall always be interested in trying to ensure that that money donated for charity is used solely for the purpose for which it was intended.

Yours faithfully,

A. G. WELCH.

10, Queensway,
Lincoln,
Lincs.

October 15th, 1961.

The Humaneness of Cyanide

Sir,—It is not altogether surprising that Mr. Pitcher has brought down such a tirade upon his head, but as it is a well-known trait in Englishmen to support lost causes perhaps one who followed Mr. Pitcher in the Uxbridge practice might be allowed a few words in mitigation, with particular reference to some details of dosage and technique which appear to have been overlooked.

The late W. H. Anderson was one of the pioneers of small-animal practice, and commencing as he did, just after the 1914-18 war he had to use the tools then available to him. A quick, simple destruction technique which could be applied by one man in a drawing room was a very necessary part of his practice. As his health and strength began to fail it became part of my duties as his student to carry the vast Gladstone bag on which his practice was founded, and I was very familiar with the contents of all its little bottles and jars. A separate pocket held a bottle of Scheele's acid, a bottle of strychnine solution and a 5-c.c. syringe. The strychnine was "Liq. Strych." to which further pellets of strychnine had been added. Five c.c. of this potent brew was injected intraperitoneally, followed at once by a similar quantity of the prussic acid. The effect was, to all outward appearance, just about all that could be desired. A vigorous, healthy dog might show some tetanic spasm for a few seconds, a seriously ailing one usually just stopped breathing. The method was commonly used for valued pets in their homes with the owner present. It was cheap enough to be used in the thousands of working-class homes of the district, and so effective that it was used just the same for film star and other well-to-do clients.

During Mr. Anderson's last illness another student, now an illustrious member of our profession on the research side, was so eloquent on the barbarity of this method that he prevailed on me to try alternatives. A captive bolt pistol for the larger dogs soon brought howls of objection from neighbours on the grounds of the bangs, and the spots of blood on the yard. An animal protection society supplied some horrible metal boxes which smelt eternally of chloroform. Just to get the terrified animal shut up in one of these involved more cruelty than the whole job with the syringe, and there was always doubt afterwards as to whether it might come round again.

Barbiturates were then a new thing and were used by a young assistant for anaesthesia. Their use for the routine destruction of the very large number of animals we were receiving at that time would have been prohibitively expensive. Anyway, we had no real cause to change; the principal was satisfied and so were the clients.

Nearly a quarter of a century has passed since those days and practicable alternatives are now available. Knowing the opposition of the profession to the technique it is, perhaps, surprising to find it still in use, and more so to find a man with the courage to admit he still uses it. Before, however, poor Mr. Pitcher's remains are fed to the waiting lions let us recall that the method was used as routine by a pioneer in small-animal practice, who over a period of 20 years was viewed with respect and affection by his clients in what was then a fairly high-class residential district.

Yours faithfully,

W. MICHAEL SALMON.

Crossways,
Howey,
Llandrindod Wells,
Radnor.

October 16th, 1961.

SCIENTIFIC

A New Serological Type of *Pasteurella multocida* from Central Africa

Sir,—It has been known for a considerable time that different serological types of *Pasteurella multocida* exist. Four principal types, denoted A, B, C and D have been identified by means of an indirect haemagglutination test (Carter, 1955).

I have examined a large number of strains of *P. multocida* recovered from haemorrhagic septicaemia occurring in various parts of the world (Carter, 1957). All the capsulated cultures were readily identified as Type B or Type I (Roberts, 1947) by the haemagglutination technique, except cultures originating from the former Belgian Congo and French Equatorial Africa (Cameroun). Red cells treated with extracts from these cultures were not appreciably clumped by Type B sera, but sera prepared with the strains from Central Africa clumped Type B treated erythrocytes at dilutions of 1:10 and 1:20.

Further study of a number of the Central African strains, employing the haemagglutination test described in detail previously (Carter, 1955) indicate that they constitute a serological variety sufficiently distinct to justify being considered a separate type and it is proposed that they be designated Type E. They would, however, appear to be more closely related to Type B than to other types in the species. Results of some of the HA tests are presented in Table I. The variation in titres can be attributed to variations in the amount of capsular substance in the saline extract. It is evident from the Table that there is sufficient serological difference between the regular Type B and these African strains to warrant separate type designation. This difference has also been observed by Perreau (1961).

If this type is shown to be the principal cause of epizootic haemorrhagic septicaemia in Central Africa, as seems likely, it is important that it be employed in the preparation of vaccines to be used in this area.

TABLE I

SEROLOGICAL SPECIFICITY OF HAEMORRHAGIC SEPTICAEMIA STRAINS FROM CENTRAL AFRICA

Erythrocytes Treated with Strains	Immune Sera: Reciprocal of HA Titre		
	2 (Congo)	8 (Cameroun)	10 (type B)
1 (Congo)	160	320	neg.
2 (Congo)	80	160	neg.
3 (Congo)	160	320	neg.
4 (Congo)	160	320	neg.
5 (Congo)	160	320	neg.
6 (Cameroun)	160	320	neg.
7 (Cameroun)	160	320	neg.
8 (Cameroun)	160	640	neg.
9 (Cameroun)	160	640	neg.
10 (type B)	20	10	640
11 (type A)	neg.	neg.	neg.
12 (type C)	neg.	neg.	neg.
13 (type D)	neg.	neg.	neg.

I wish to express my thanks to Professor Schoenaers (Brussels) and to Dr. Perreau (Alfort) for submitting the African cultures, and to acknowledge the technical assistance of Mr. John Muysson.

Yours faithfully,

G. R. CARTER.

Animal Pathology Laboratories,
Health of Animals Division,
Canada Department of Agriculture,
Hull,
Quebec,
Canada.

October 12th, 1961

References

CARTER, G. R. (1955). *Amer. J. vet. Res.* **16.** 481.
———. (1957). *Ibid.* **20.** 173.
ROBERTS, R. S. (1947). *J. comp. Path.* **57.** 261.
PERREAU, P. (1961). Personal communication.

DISEASES OF ANIMALS ACT, 1950—GREAT BRITAIN

Summary of Returns of Confirmed Outbreaks of Scheduled (Notifiable) Diseases

Period		Anthrax	Atrophic Rhinitis	Foot-and-Mouth	Fowl Pest	Sheep Scab	Swine Fever
16th to 30th September, 1961		22	—	—	29	—	40
Corresponding period in	1960	5	—	1	42	—	48
	1959	14	—	—	39	—	81
	1958	7	—	—	34	—	34
1st January to 30th September, 1961		163	—	103	847	—	860
Corresponding period in	1960	159	1	21	1,451	—	888
	1959	181	1	9	540	—	925
	1958	119	5	114	537	—	990

TUBERCULOSIS ORDER OF 1938

The number of bovine animals slaughtered under the Tuberculosis Order of 1938 during the period 1st July to 30th September 1961, was 6.

FOOT-AND-MOUTH DISEASE—FINAL FIGURE

The number of animals slaughtered as diseased or exposed to infection for the period 1st January to 30th September 1961 was 25,056.